An Assessment of the Potential Waterfowl Carrying Capacity for Existing and Proposed Alternative Refuge Closed Areas on Pools 4 - 14 of the Upper Mississippi River

Prepared By

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Funded by U.S. Fish and Wildlife Service,
Upper Mississippi River National Wildlife and Fish Refuge.

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Introduction

The distribution and abundance of food resources influences waterfowl use of the Upper Mississippi River (UMR). Areas closed to migratory bird hunting on the UMR ("Closed Areas")were established in 1957 based on the distribution of vegetation communities, routes of public entry for boating traffic, and Refuge management objectives to provide diving and dabbling duck habitat. Changes in the availability of food resources have altered the movement and behavior of waterfowl during migration and the distribution of birds on the UMR. Consequently, UMR resource managers are interested in evaluating changes in the distribution and abundance of vegetation communities and to assess the suitability of existing Closed Areas and Alternative Closed Area configurations to provide adequate protection to waterfowl and other birds on the UMR.

The abundance of important waterfowl plant foods among vegetation communities is based on work conducted by Kenow et al. (unpublished report) on Navigation Pools 7 and 8 in 1995 and 1996. Seeds and tubers were sampled from 9 selected vegetation classes. Recently, the UMR Long Term Resource Monitoring Program (LTRMP) changed its habitat classification for all UMR land cover / land to a classification system using 31 vegetation classes. Seed and tuber production estimates from the 9 original stratums were converted to this new classification system and estimates developed for the 6 primary wetland habitats of the 31 LTRMP classes (Table 1). The remaining classes for which no estimates were derived were combined as 'other' land use types. Waterfowl plant food production estimates were then extrapolated to larger land areas using a GIS application model (Slivinski et al., unpublished) and converted to waterfowl plant food gross energy estimates (Table 2). Extrapolated production estimates consider sample variance. The recent development of an Environmental Pool Plan (River Resources Forum, 2004) provides desired pool conditions necessary to improve habitat quality to that of a more sustainable ecosystem. Desired future pool conditions were created for pool 1-10. However, the use of a different habitat classification system and of an older base map (1989) prevented me from developing estimate of food plant productivity for the future pool plans and thus the potential improvement in each pools carrying capacity.

Methodology

This project spans over 12 pools (Pool 4, 5, 5A and 6-14) and includes 32 Refuge closed areas. I used a GIS model (Slivinski et al., unpublished report) to assess relative potential plant food energy values of land cover for areas under consideration as Closed Areas. The model uses the boundary of an area to extract land cover information from the land cover/use data sets and provides the size of each habitat. I used land cover/use data sets interpreted from 2000 aerial photography as they are currently the most recent land cover /use coverages available. These can be downloaded from http://www.umesc.usgs.gov web site. Using the land cover area extracted for each closed area boundary, the tool estimates seed and tuber production, and total potential plant food gross energy. The same estimates can also be derived using Table 2 and proper unit conversion. The results thus provide a metric to compare energetic equivalents for various alternative Refuge closed area configurations.

Table 1. Description of habitat classification categories sampled to estimate energetic values and description of remaining habitat classes combined as 'Other'.

Class 31 Used For Energy Estimates	
DMA	Deep Marsh Annual
DMP	Deep Marsh Perennial
OW	Open Water
RFA	Rooted Floating Aquatics
SMP	Shallow Marsh Perennial
SV	Submerged Aquatic Veg
WM	Wet Meadow

Class 31 Combined as Other Habitat Types			
AG	Agriculture	**PS**	Pasture
CN	Conifers	**RD**	Roadside Grass/Forbs
DMS	Deep Marsh Shrub	**SB**	Sand Bar
DV	Developed	**SC**	Salix Community
FF	Floodplain Forest	**SD**	Sand Dunes/Spoil
GR	Grassland	**SM**	Sedge Meadow
LF	Lowland Forest	**SMA**	Shallow Marsh Annual
LV	Levee	**SMS**	Shallow Marsh Shrub
MUD	Mud	**SS**	Scrub-Shrub
NPC	No Photo Coverage	**UF**	Upland Forest
PC	Populus Community	**WMS**	Wet Meadow Shrub
PN	Plantation	**WS**	Wooded Swamp

Table 2. Average seed yield and tuber production for selected land cover types, collected from Pools 7 and 8 of the Upper Mississippi River (from Kenow et al., unpublished report).

Selected Land Cover Types	Seed Yield				Tuber Production			
	Mean(g/m2)	± Var	Kcal/m2	± Var	Mean(g/m2)	± Var	Kcal/m2	± Var
Deep Marsh Annual	35	614	154	11,820	0	0	0	0
Deep Marsh Perennial	6	18	25	371	373	65	1,756	309
Open Water	0	0	1	1	0	0	2	2
Rooted Floating Aquatic	2	4	9	71	10	5	43	24
Shallow Marsh Perennial	5	6	21	118	19	15	90	70
Submerged Vegetation	0	0	1	2	40	16	174	77
Wet Meadow	4	2	14	30	4	4	15	15

Following intensive public meetings and in-house review, Refuge managers developed four alternative Refuge closed area proposals for the pools listed above. The alternatives include: A – No action: Existing conditions;
B - Wildlife Focus; C - Public Use Focus; and D - Wildlife and Integrated Public Use Focus. For each pool, different approaches were used to develop the three alternative proposals. These included changing the boundary of a Closed Area, adding a new Closed Area, or removing an existing Closed Area. For each pool, a series of maps was created. The first map provides the level of waterfowl plant food gross energy per m^2 for each pool using the selected land cover types (Table 2) for which data was available. Information on the location of all alternative Closed Areas and of the pool's Refuge boundary is also included. The map provides an excellent visual representation of the proposed Closed Area locations in relation to the pool's most productive areas. The second map provides habitat information for existing Closed Areas and proposed alternatives from which total gross food plant energy estimates were derived. For clarity, some Closed Areas were mapped both at a small and large scale thus showing the change in closed area configuration within the entire pool and also emphasizing habitat distribution within each Closed Area. A table summarizing area, seed and tuber production, gross plant food energy, and gross energy/acre is also included in this second map. Estimates and percent change from the existing closed area can then be used to compare the potential effect of the alternative changes proposed. Additional tables are also included in Appendix 1 detailing seed and tuber production and gross energy estimates for each closed area within each pool and for a pool's entire Refuge area.

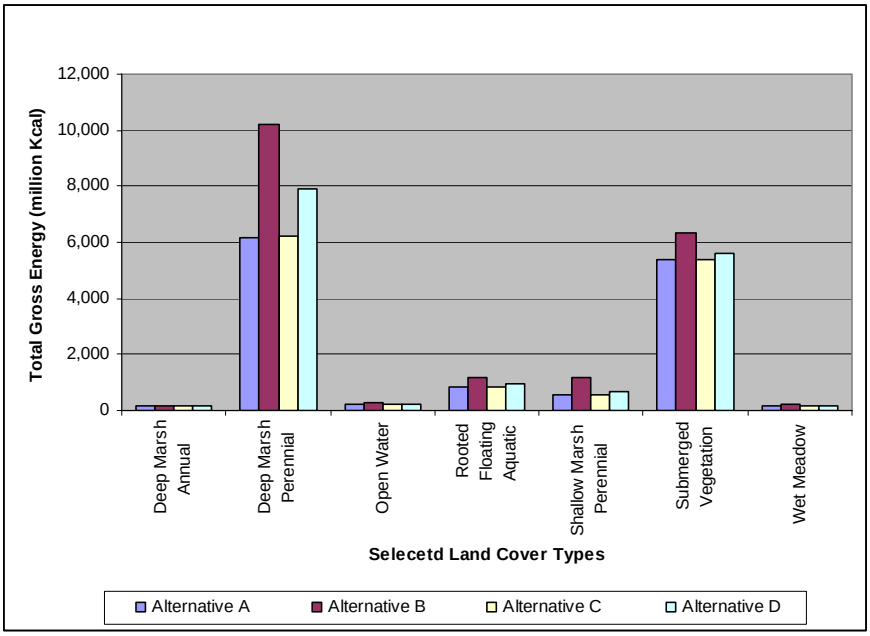
Results and Discussion

Table 3 provides a summary of area, gross plant food energy, and percent change in estimated production anticipated under each alternative relative to the existing Closed Area configuration (Alternative A) for all 32 closed areas combined. Of the alternative options developed, estimated waterfowl plant food production is greatest on Closed Area encompassed under alternative B (45% increase) and thus this alternative would most benefit the Refuge closed area system's carrying capacity. The majority of the changes are reflected in the addition of Deep Marsh Perennial and Shallow Marsh Perennial (Figure 1). Submerged Vegetation provides the second most important source of waterfowl plant food production. The changes to Closed Area configurations, as discussed further below, are primarily in pools 4, 8, 10, and 13. Except for pool 7 and 8, closed areas in Alternative C were not changed from the existing (Alternative A) closed areas. Alternative D provides some improvement to the Refuge system closed area carrying capacity (16% increase). Most of the change under Alternative D is associated with gains in Pools 4, 8, and 10. Figure 2 provides total estimated waterfowl plant food gross energy for each alternative in each closed area.

Table 3. Estimated waterfowl food plant production (gross energy) in Closed Areas on Pools 4-14 of the UMR under four alternative Closed Area configurations.

Selected Land Cover Types	Refuge		Alternative A Closed Areas		Alternative B Closed Areas			Alternative C Closed Areas			Alternative D Closed Areas		
	Total Area (Acres)	Plant Food Energy (million Kcal)	Total Area (Acres)	Plant Food Energy (million Kcal)	Total Area (Acres)	Plant Food Energy (million Kcal)	% Change	Total Area (Acres)	Plant Food Energy (million Kcal)	% Change	Total Area (Acres)	Plant Food Energy (million Kcal)	% Change
Deep Marsh Annual	482	300	280	174	280	174	0%	280	174	0%	240	150	-14%
Deep Marsh Perennial	5,496	39,606	852	6,142	1,431	10,313	68%	863	6,222	1%	1,119	8,064	31%
Open Water	95,734	1,110	18,771	218	22,819	265	22%	18,823	218	0%	18,777	218	0%
Rooted Floating Aquatic	19,091	4,051	3,957	840	5,743	1,219	45%	3,984	845	1%	4,428	940	12%
Shallow Marsh Perennial	11,354	5,112	1,202	541	2,579	1,161	115%	1,192	537	-1%	1,534	691	28%
Submerged Vegetation	20,978	14,801	7,659	5,404	9,009	6,356	18%	7,649	5,396	0%	7,937	5,600	4%
Wet Meadow	10,586	1,237	1,281	150	1,770	207	38%	1,292	151	1%	1,280	150	0%
Other Cover	70,112	0	9,968	0	16,846	0		10,008	0		8,506	0	
Total	**234,327**	**66,217**	**43,970**	**13,625**	**60,476**	**19,694**	**45%**	**44,091**	**13,701**	**1%**	**43,821**	**15,811**	**16%**

Figure 1. Distribution of estimated waterfowl food plant production (gross energy) in Closed Areas across Pools 4-14 among selected land cover types.



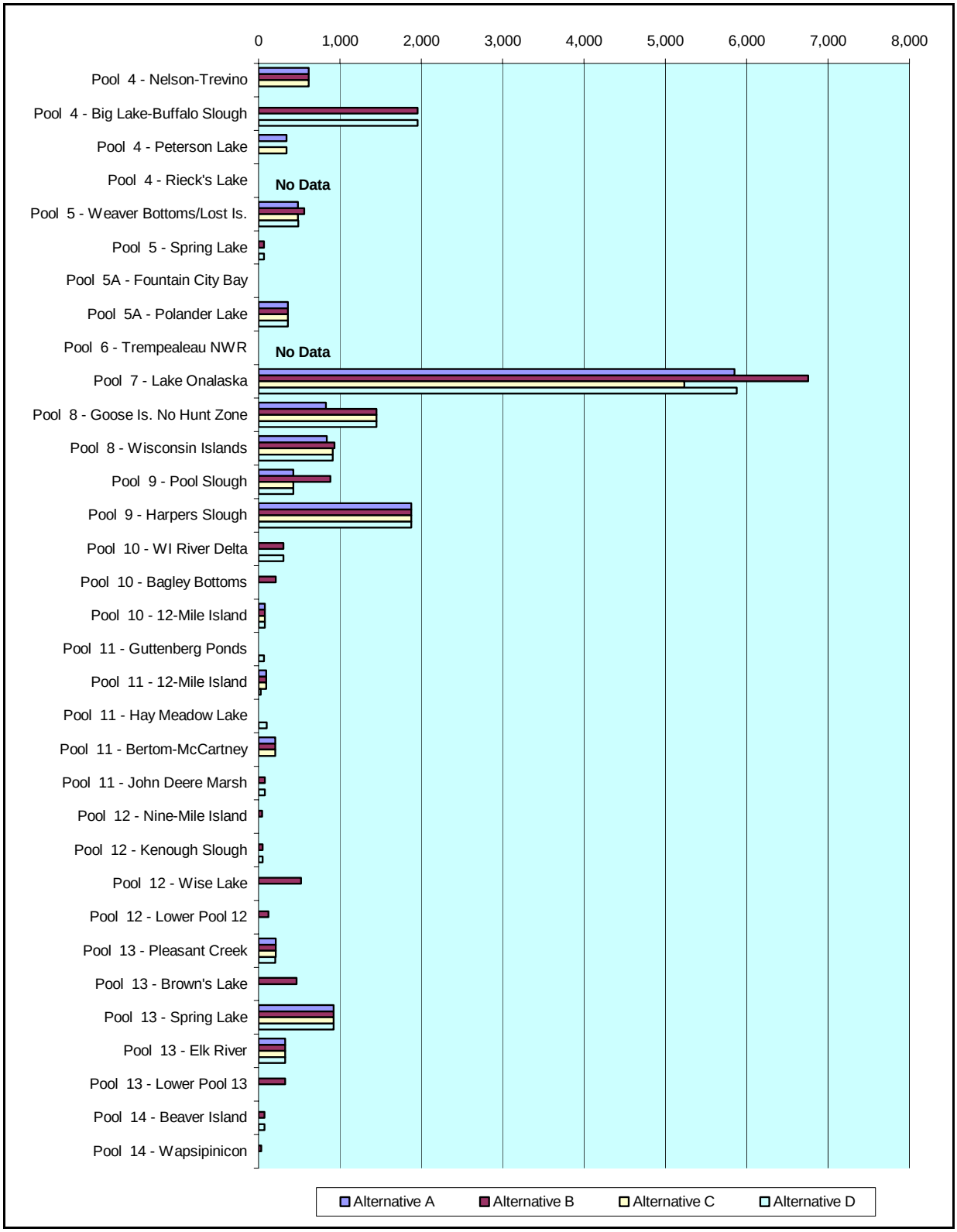


Figure 2. Waterfowl food plant production (gross energy) estimates for proposed alternatives A, B, C, and D for all 32 closed areas located between Pools 4-14 of the UMR.

There is also considerable variability in the amount of waterfowl food plant production within each closed area relative to the total production throughout the Refuge (Table 4). Pools which would most benefit from changes prescribed under alternative B include 4, 10, 12, and 14. Alternatives A, C, and D in Pools 7, 9, 11, and 12 would provide such small benefits, that changing closed area boundaries on these pools would be questionable given the time and cost necessary to undertake such an effort.

Table 4. Percent of the Refuge's total waterfowl food plant production estimated to be in closed areas for each alternative.

Pool	Refuge million Kcal	Alternative A	Alternative B	Alternative C	Alternative D
4	4,230	23%	61%	23%	46%
5	2,124	23%	30%	23%	26%
5A	3,366	15%	16%	15%	16%
6	604	n/a	n/a	n/a	n/a
7	12,658	46%	53%	41%	46%
8	12,393	13%	19%	19%	19%
9	16,810	14%	16%	14%	14%
10	2,689	3%	22%	3%	14%
11	2,083	15%	18%	15%	13%
12	2,526	n/a	29%	n/a	2%
13	6,928	21%	33%	21%	21%
14	410	n/a	26%	n/a	17%

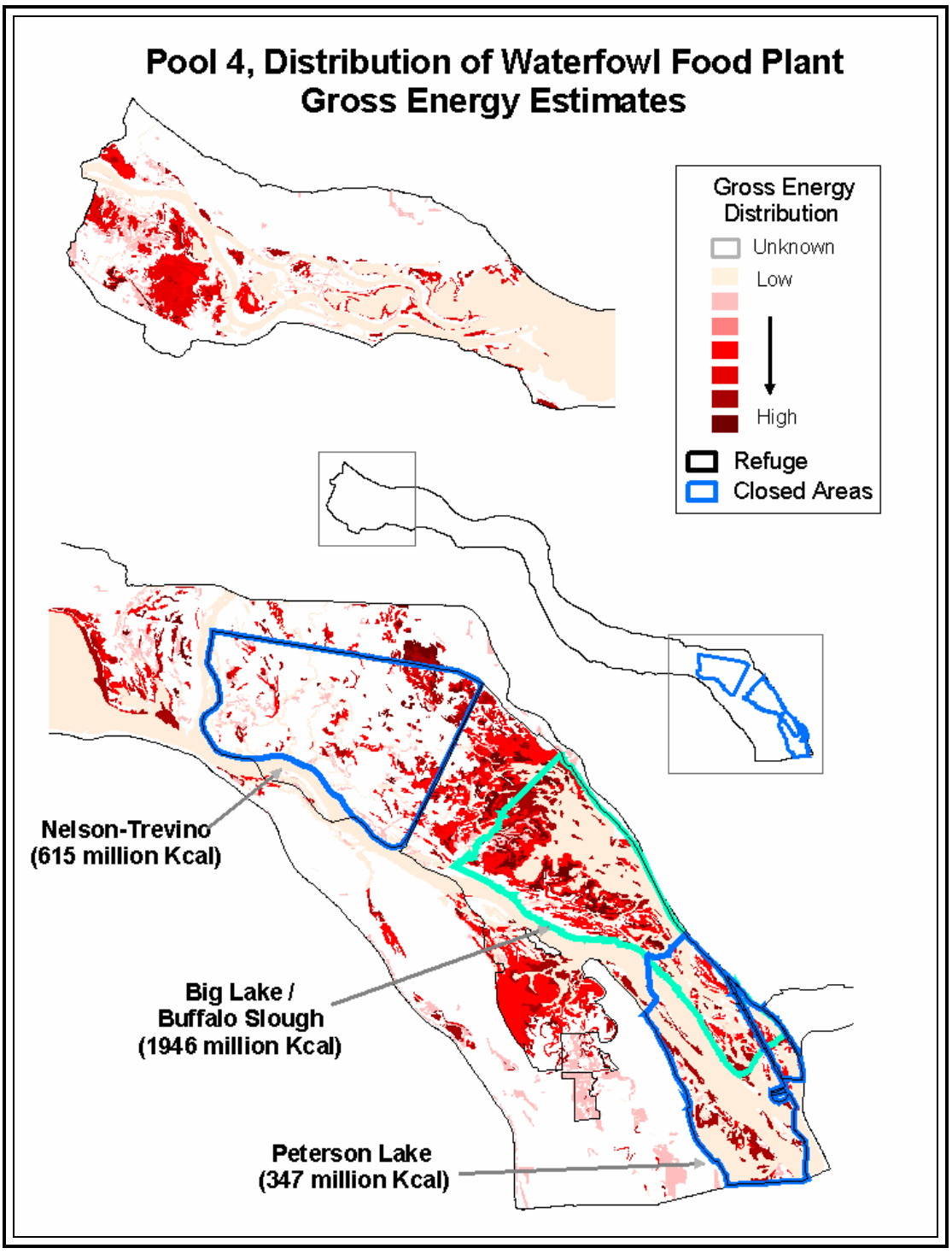
Following is a pool by pool summary of findings and recommendations. Detailed tables of all the 32 closed area waterfowl food plant production (gross energy) and variance estimates are included in Appendix 1. Each pool summary refers to both map types included and refers to gross energy estimates provided in Appendix 1.

The *Map of Distribution of Waterfowl Food Plant Production* presented indicates where closed areas are located in relation to the distribution of cover types productive of waterfowl plant foods. It will be necessary for the reader to refer to the second map simultaneously as it provides location of alternative closed areas and detail of plant food production estimates.

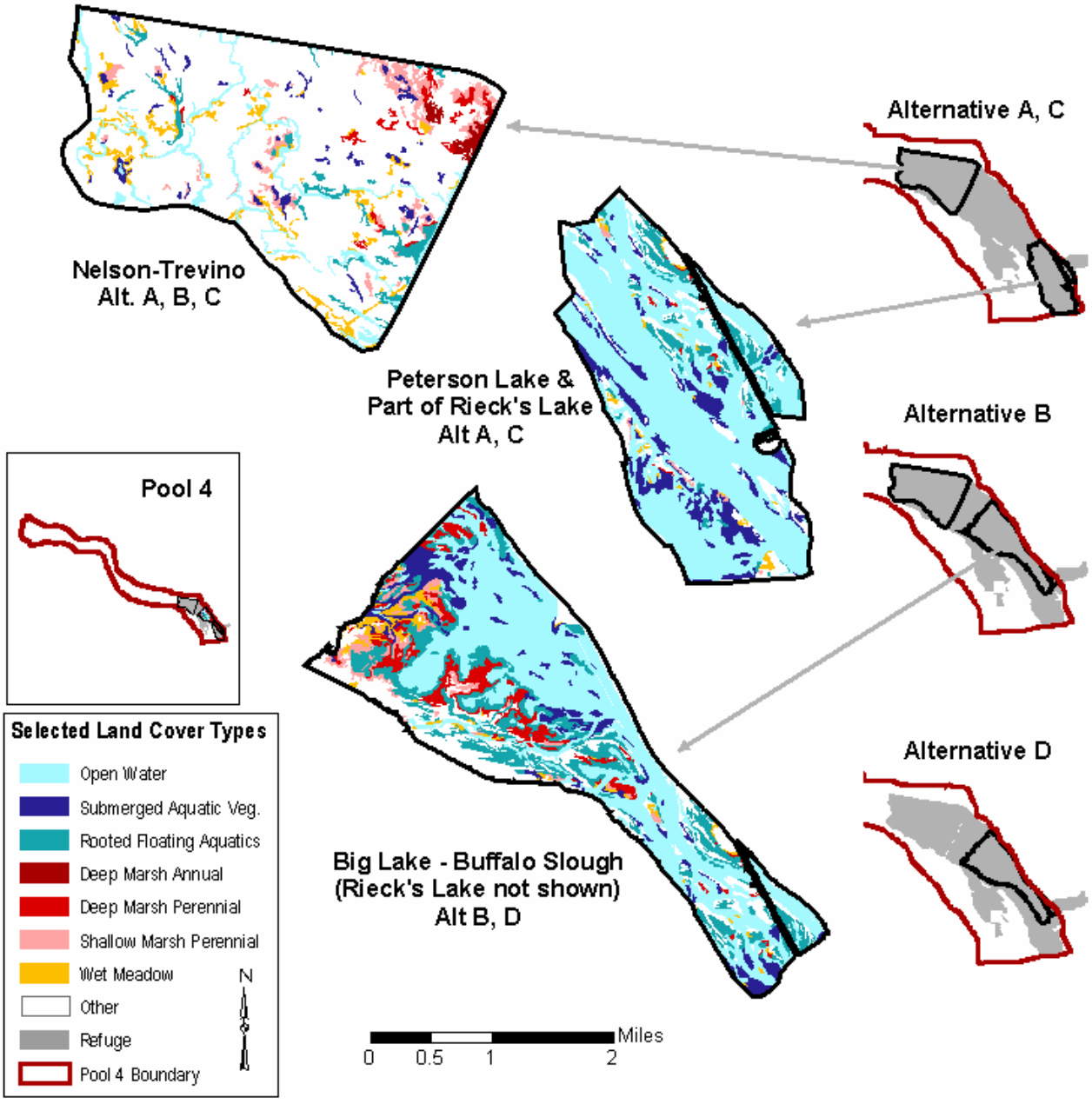
The majority of the refuge's habitat supporting a high level of gross plant food energy occurs in Pools 7, 8, and 9. The refuge's northern Pools (4, 5, 5a, and 6) are smaller than those three and also have lower total gross plant food energy production. If the ultimate objective of the proposed closed areas would have been gross plant food energy production, then several of the suggested closed areas would have served the purpose better by being located elsewhere as noted in the following pool by pool summary. Future effort should also be placed in adding production estimates for forested land class.

Pool 4

The closed areas in pool 4 currently account for 23% of the pools Refuge gross plant food production estimates. Selecting alternative B would result in protecting 61% (2,571 million Kcal) of the pool's gross plant food energy production within the Refuge boundary. Big Lake / Buffalo Slough closed area adds 1,956 million Kcal alone, a significant improvement. As seen in the map below, however, a large area between Big Lake and Nelson Trevino is not included in any closed areas and consists of the most productive area in terms of gross plant food energy. It is also noteworthy that the northern part of the pool which is outside of the Refuge boundary includes a mid to high level of gross plant food energy production concentration as well.



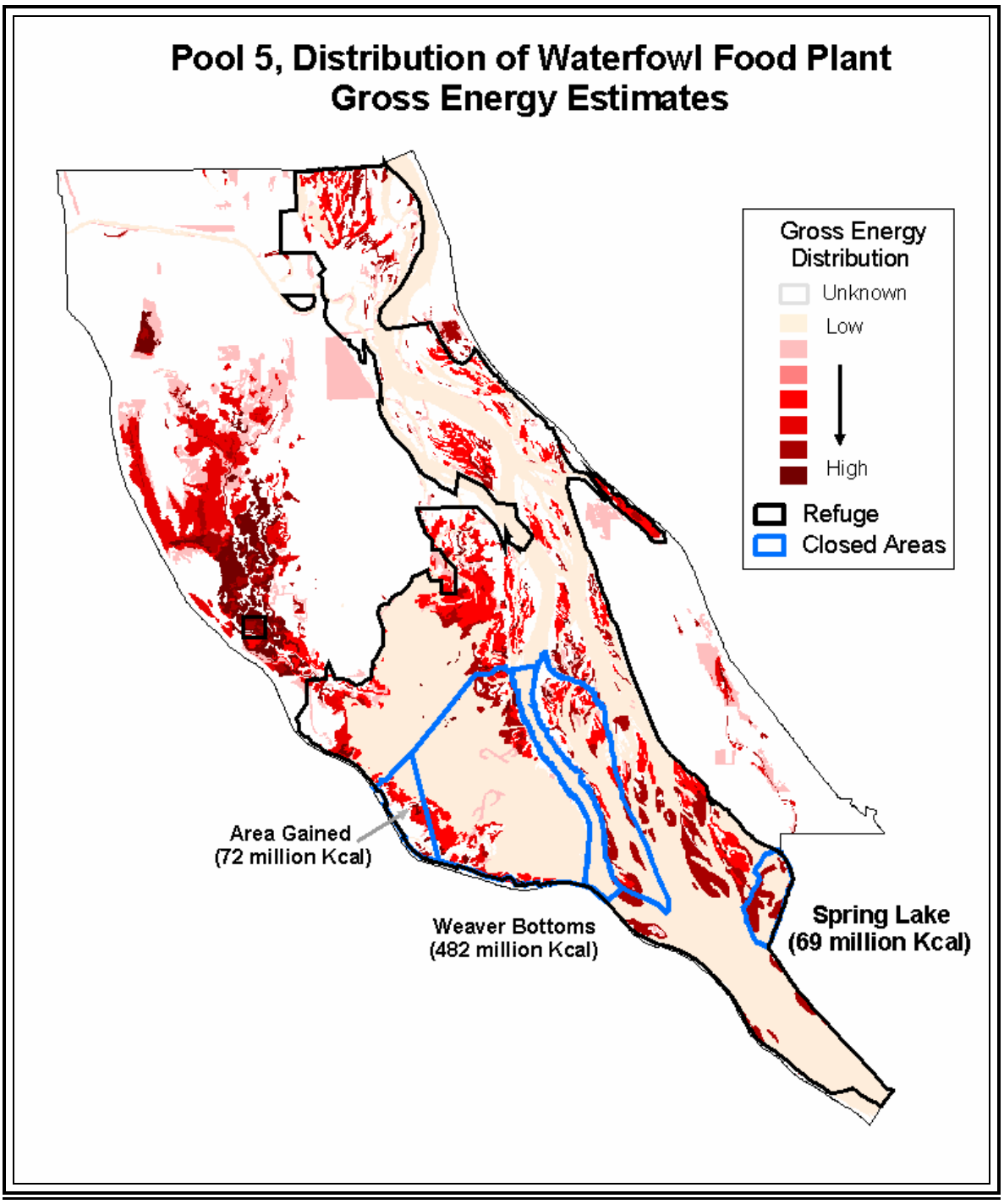
Pool 4, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Refuge Closed Areas



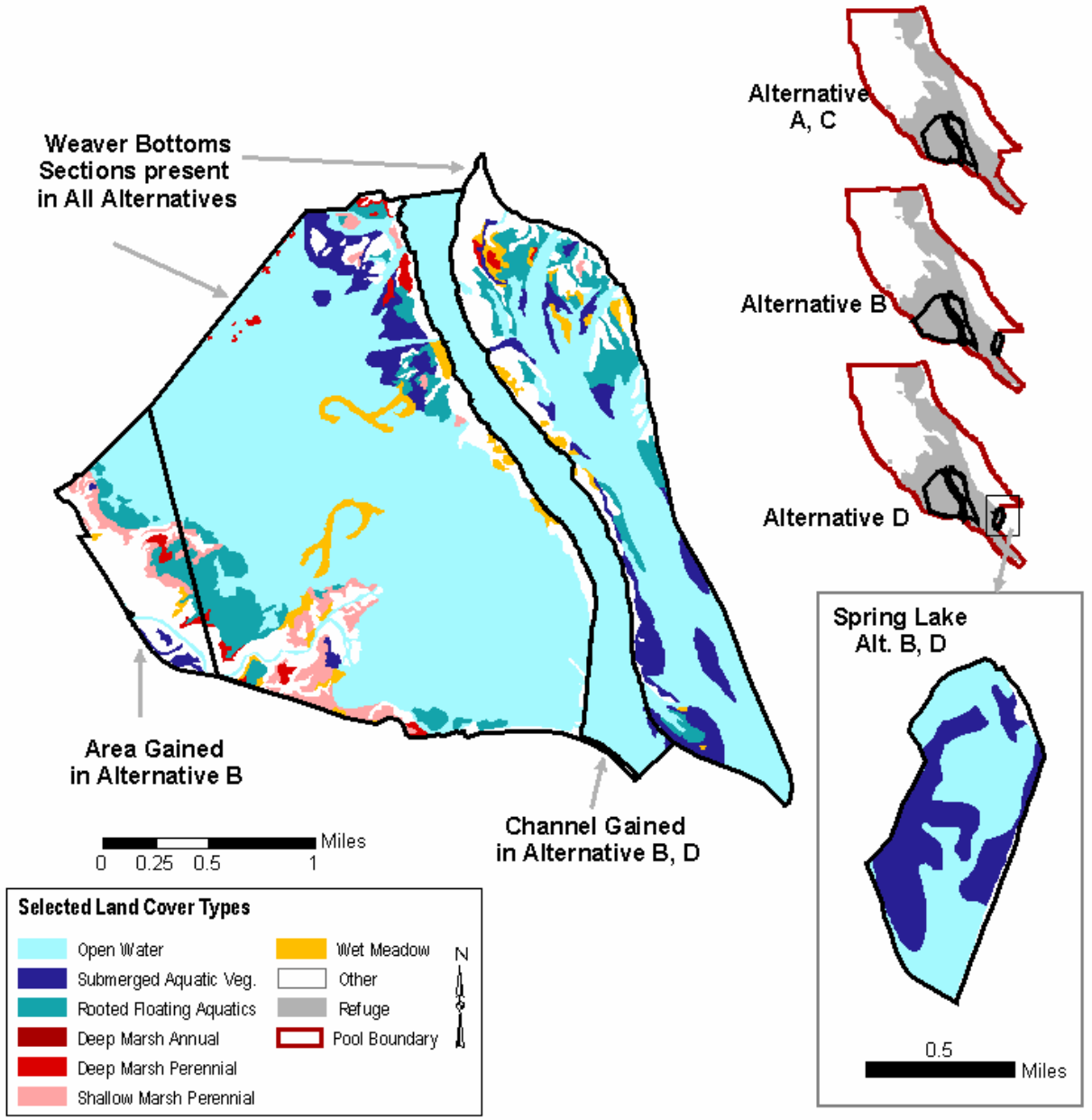
	POOL 4 SUMMARY OF PROPOSED ALTERNATIVES							POOL 4 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use Focus		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	6,386	7,023	10%	6,386	0%	3,250	-49%	13,040
Seed (Million Kcal)	75	122	61%	75	0%	63	-17%	214
Tuber (Million Kcal)	887	2,450	176%	887	0%	1,893	114%	4,016
Gross Energy (Million Kcal)	962	2,571	167%	962	0%	1,956	103%	4,230
Energetics/Acre	0.15	0.37	143%	0.15	0%	0.60	300%	0.32

Pool 5

Pool 5 Refuge has 2,124 million Kcal of waterfowl plant food gross energy production. This is similar to pools 10, 11, and 12. The distribution map shows that a larger proportion of the pools waterfowl plant food gross energy is produced outside the Refuge boundary. Although the addition of Spring Lake improves the protection of areas with Submerged Vegetation, and thus increases waterfowl plant food gross energy production in this closed area ,there is very little change gained with alternative B and D; both are a small improvement to alternative A. Alternative C is identical to alternative A.



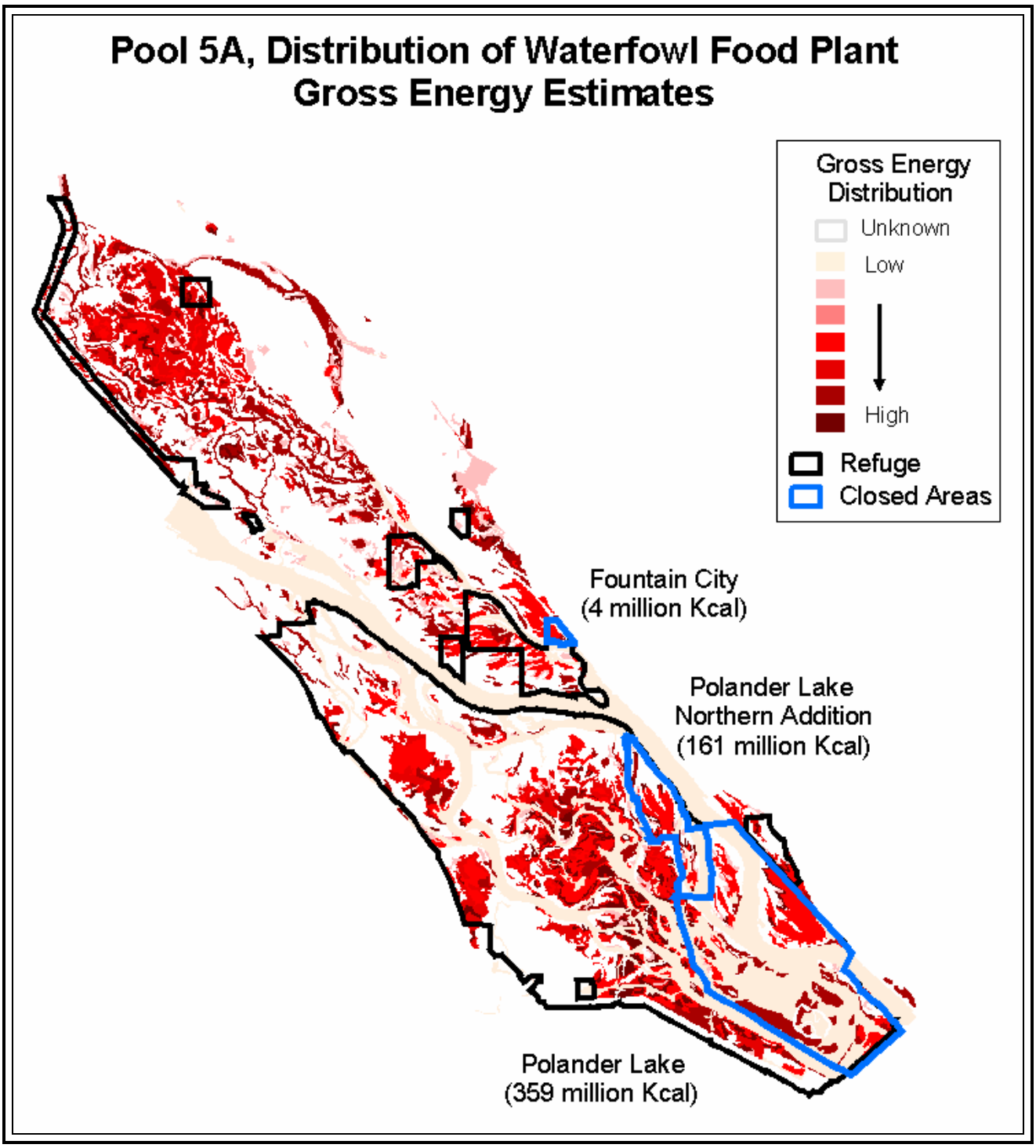
Pool 5, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Refuge Closed Areas



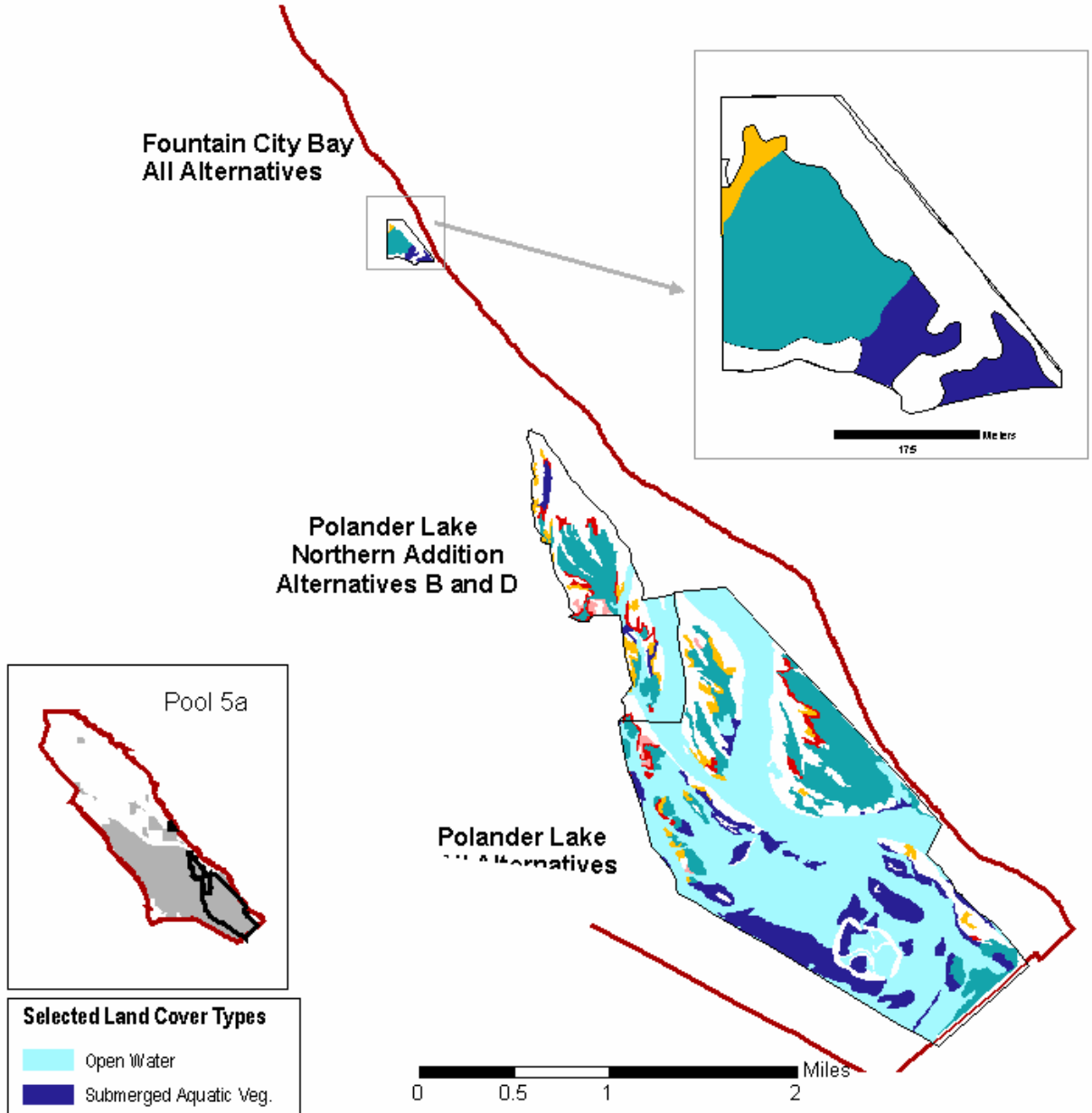
	POOL 5, SUMMARY OF PROPOSED ALTERNATIVES							POOL 5 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use Focus		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	3,139	4,024	28%	3,139	0%	3,752	20%	14,466
Seed (Million Kcal)	31	37	21%	31	0%	33	6%	135
Tuber (Million Kcal)	452	593	31%	452	0%	525	16%	1,989
Gross Energy (Million Kcal)	482	630	31%	482	0%	557	16%	2,124
Energetics/Acre	0.15	0.16	109%	0.15	0%	0.15	80%	0.15

Pool 5A

Only a minor change was proposed to the closed area system of pool 5A. It is the addition of the 24 acres Fountain City Bay closed area which includes 4 million Kcal. Analysis of habitat composition reveals that 10 % of the entire pools Refuge waterfowl plant food gross energy production is located within the Polander Lake closed area (359 million Kcal). Larger more productive areas lay north of the lake within the Refuge boundary and at the northern tip of the pool outside the Refuge boundary.



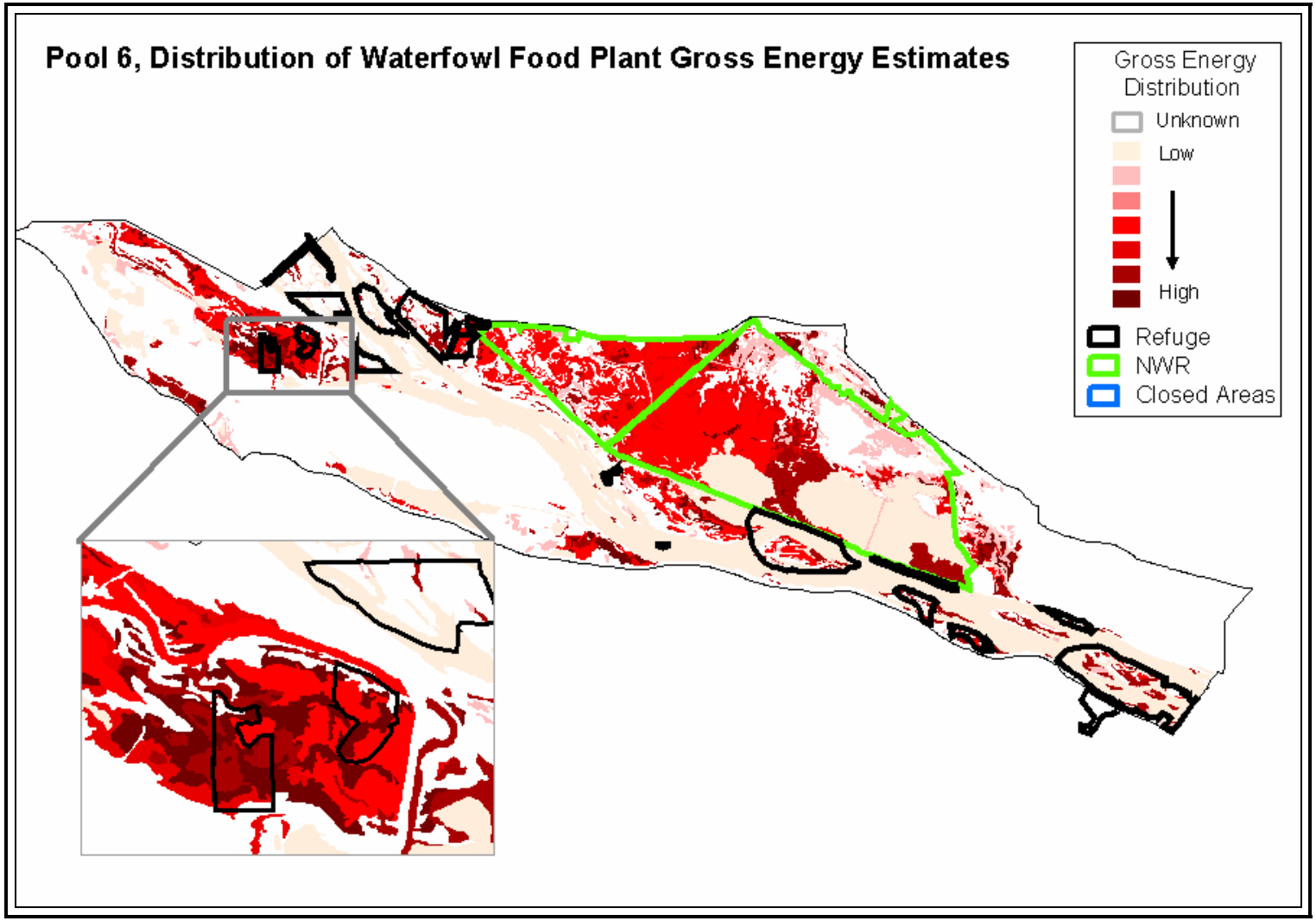
Pool 5a, Gross Energy Estimates for Existing and Alternative Refuge Closed Areas



POOL 5, SUMMARY OF PROPOSED ALTERNATIVES								POOL 5 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use Focus		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	1,600	2,111	32%	1,600	0%	2,111	32%	4,884
Seed (Million Kcal)	17	23	37%	17	0%	23	37%	138
Tuber (Million Kcal)	347	501	45%	347	0%	501	45%	3,228
Gross Energy (Million Kcal)	363	524	44%	363	0%	524	44%	3,366
Energetics/Acre	0.23	0.25	139%	0.23	0%	0.25	139%	0.69

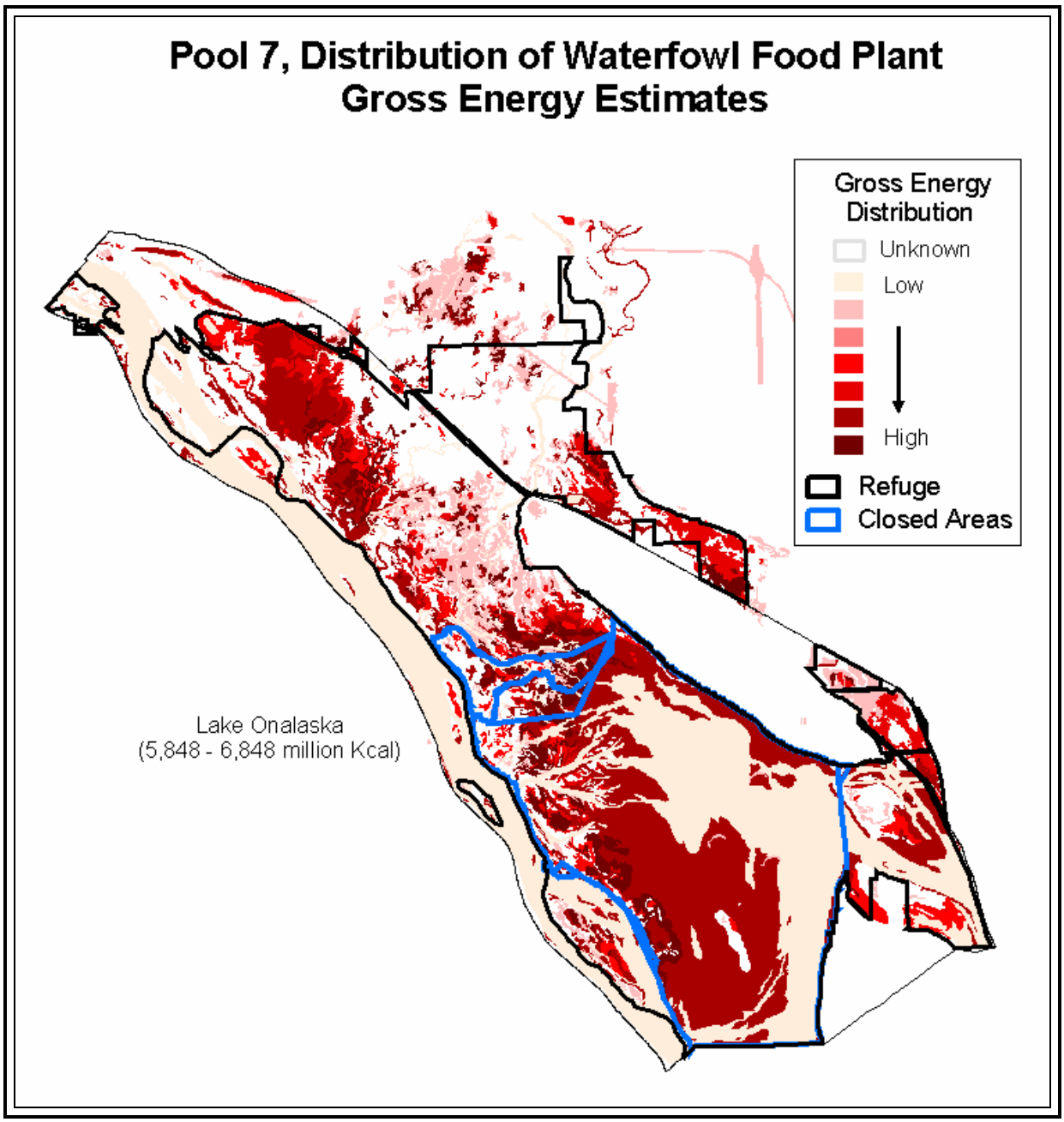
Pool 6

Following is the distribution of waterfowl plant food gross energy on pool 6 where no closed areas were proposed. Also shown on the Map is the boundary of the Trempealeau National Wildlife Refuge (NWR). The restricted hunting regulations allow the refuge to function essentially as a closed area along the northern reach of the river where most of the higher waterfowl plant food gross energy production is located. The Refuge carrying capacity could be greatly increased by changing some of the Refuge boundaries to include the area enlarged. This includes small areas of high concentrations of Deep Marsh Perennial and Submerged Vegetation.

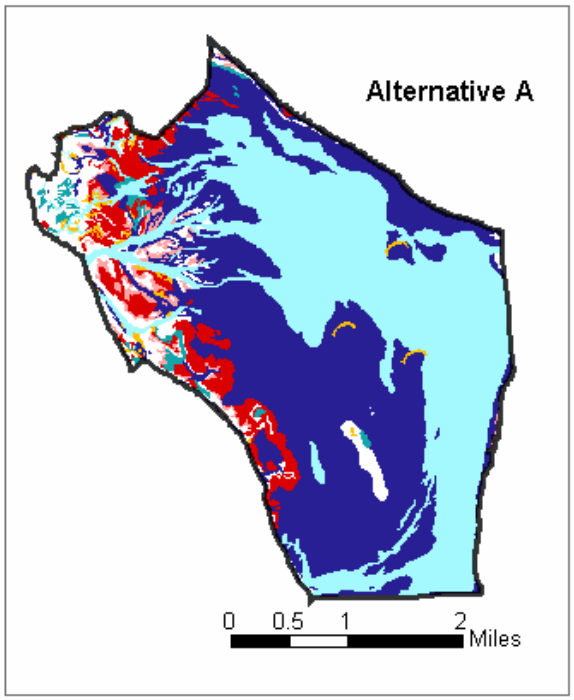


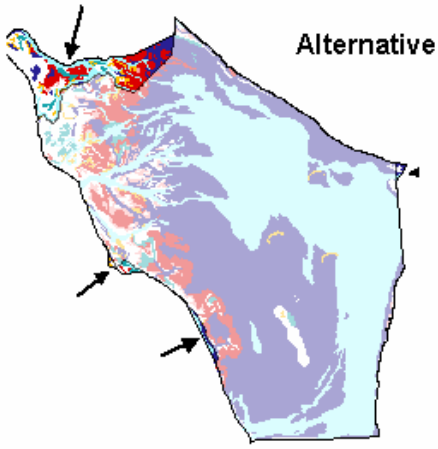
Pool 7

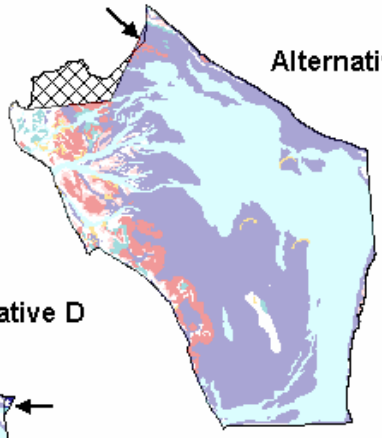
As previously shown in Figure 2, Lake Onalaska closed area encompasses the largest amount of waterfowl plant food gross energy of all closed areas evaluated. This is attributed to its large expense of Submerged Vegetation. The closed area encompasses 46% of the gross food plant energy estimates produced within the boundary of the Refuge on Pool 7. The various alternative closed areas proposed range from 5,232 - 6,848 million Kcal. Alternate B accounts for the greatest increase (16%) including the addition of over 100 acres of Deep Marsh Perennial. However, the addition of a northwest section to Lake Onalaska misses a very productive Refuge area on the northeast side. Alternative C would reduce the waterfowl plant food gross energy estimates by 11% while alternative D would result in no noticeable changes. Except for the alternative B changes proposed on the northwest part of the Lake, other changes are so small that may not be sufficient to justify the time and effort to reset the boundary of this closed area.

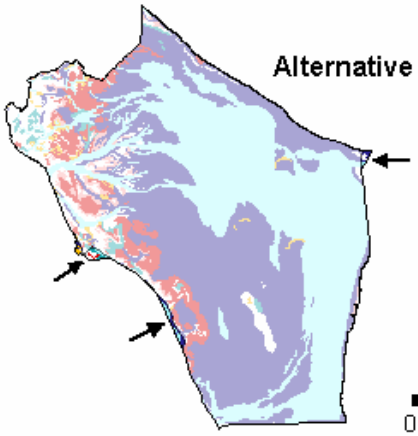


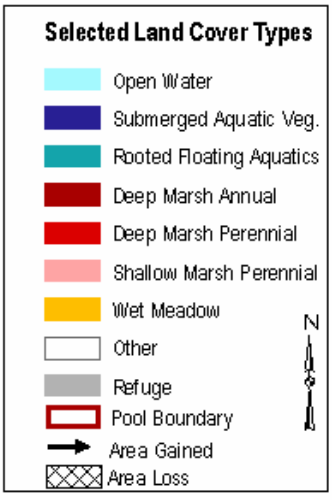
Pool 7, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Refuge Closed Areas

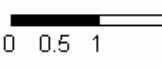


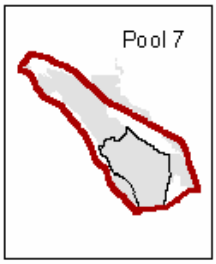






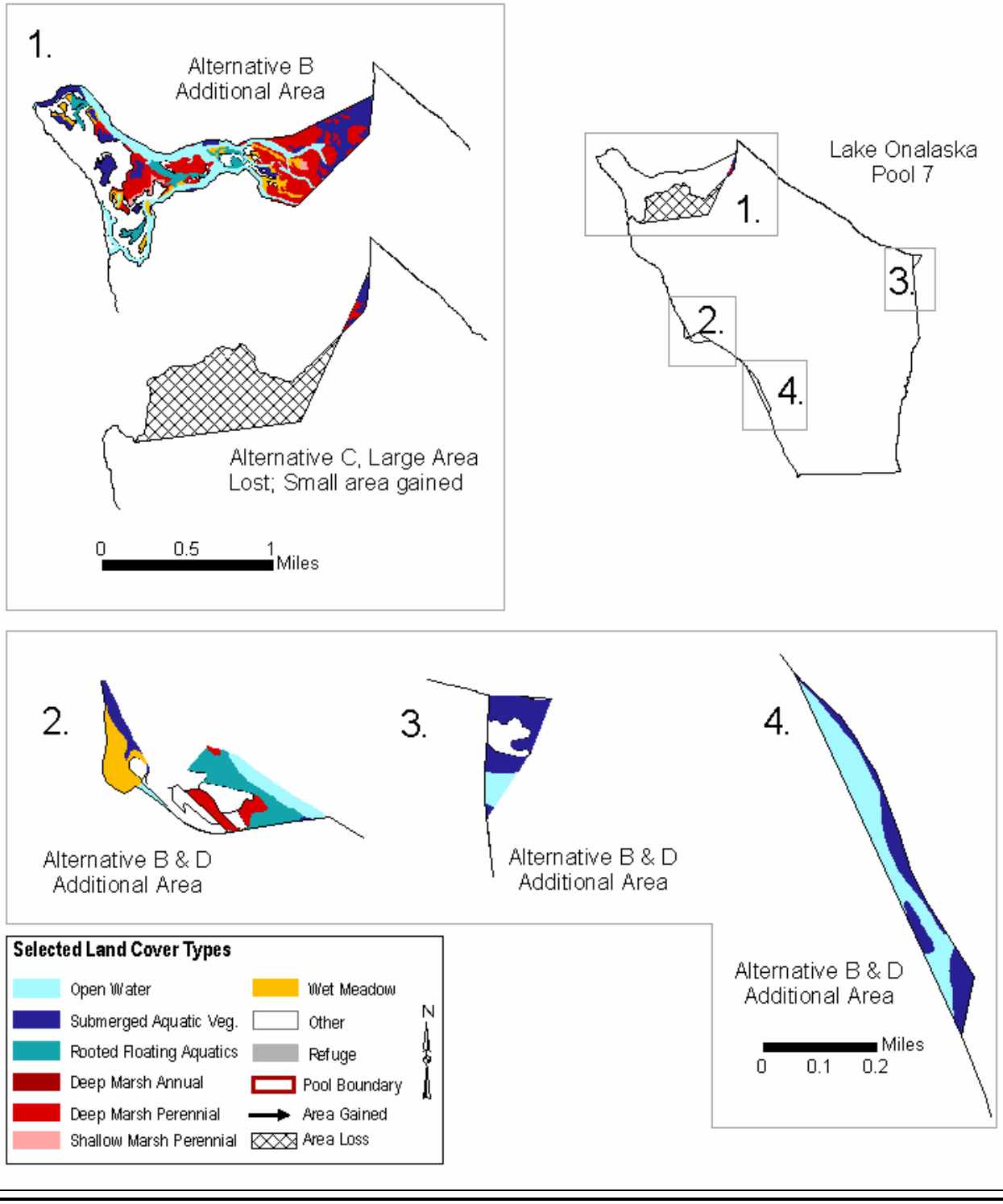






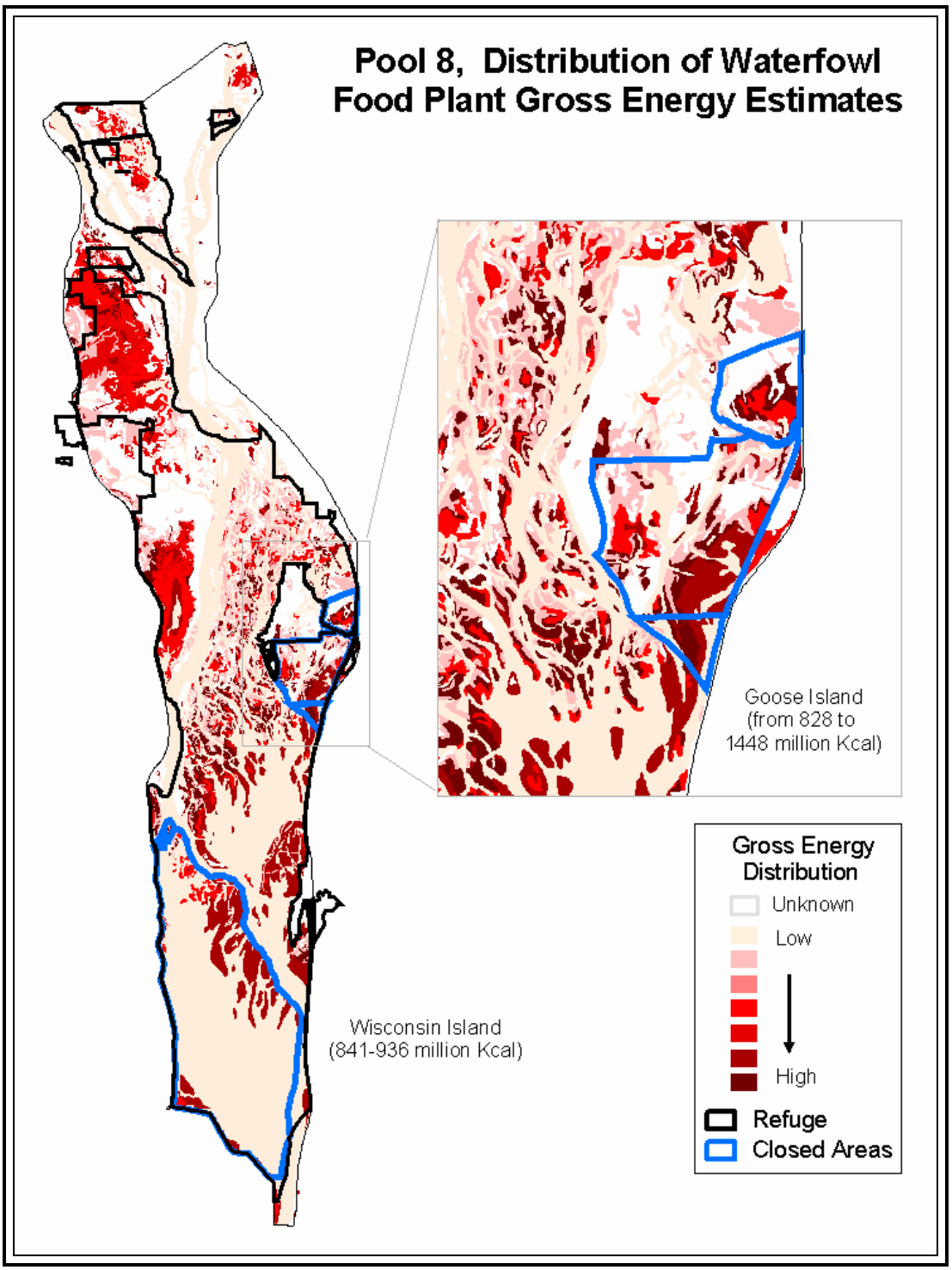
	POOL 7, SUMMARY OF PROPOSED ALTERNATIVES							POOL 7 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	7,347	7,878	7%	7,103	-3%	7,399	1%	18,487
Seed (Million Kcal)	86	101	18%	76	-12%	86	1%	410
Tuber (Million Kcal)	5,762	6,656	16%	5,156	-11%	5,791	0%	12,248
Gross Energy (Million Kcal)	5,848	6,757	16%	5,232	-11%	5,877	0%	12,658
Energetics/Acre	0.80	0.86	8%	0.74	-7%	0.79	0%	0.68

Pool 7, Land Cover Focus for Alternative Lake Onalaska Closed Area

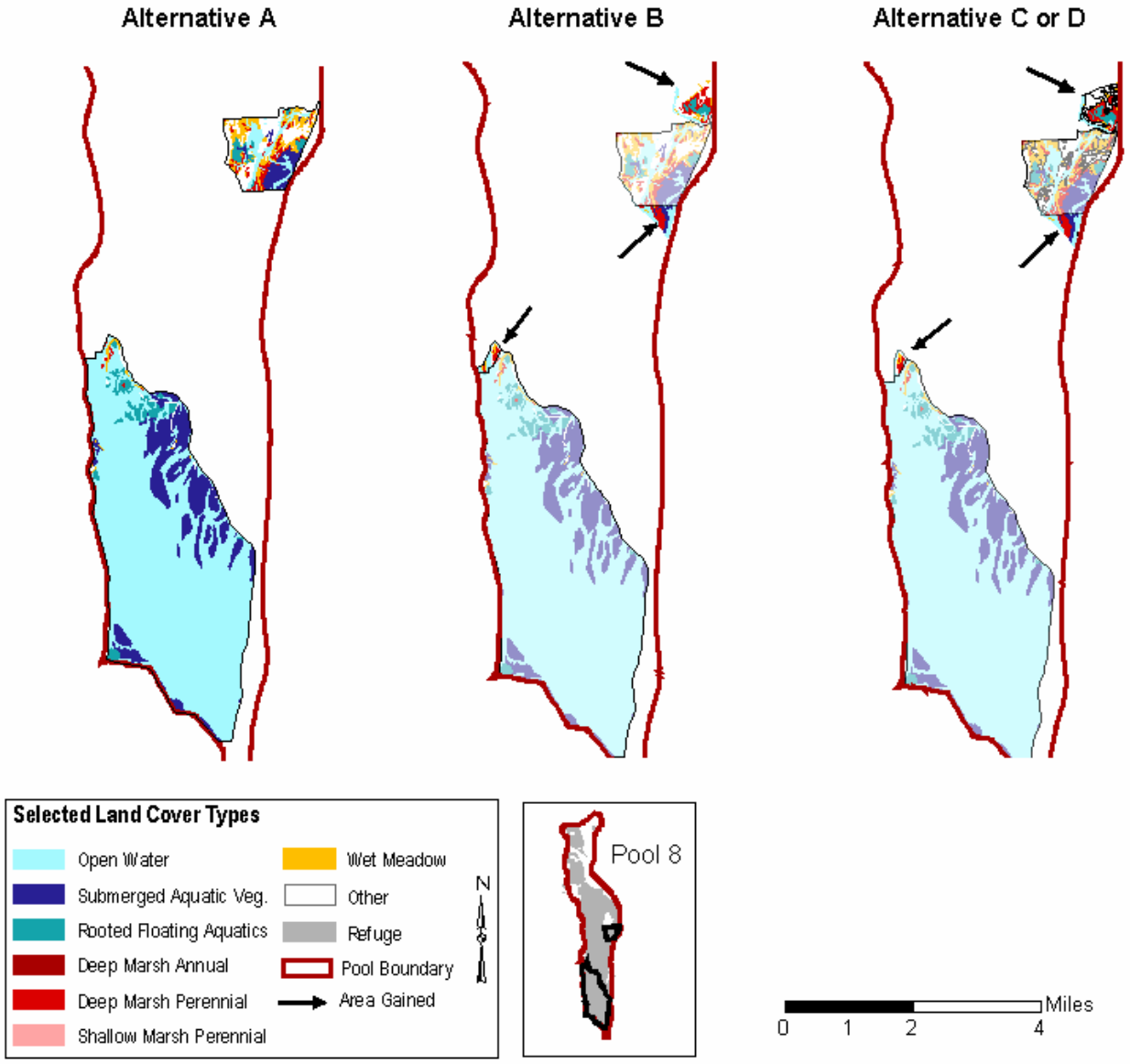


Pool 8

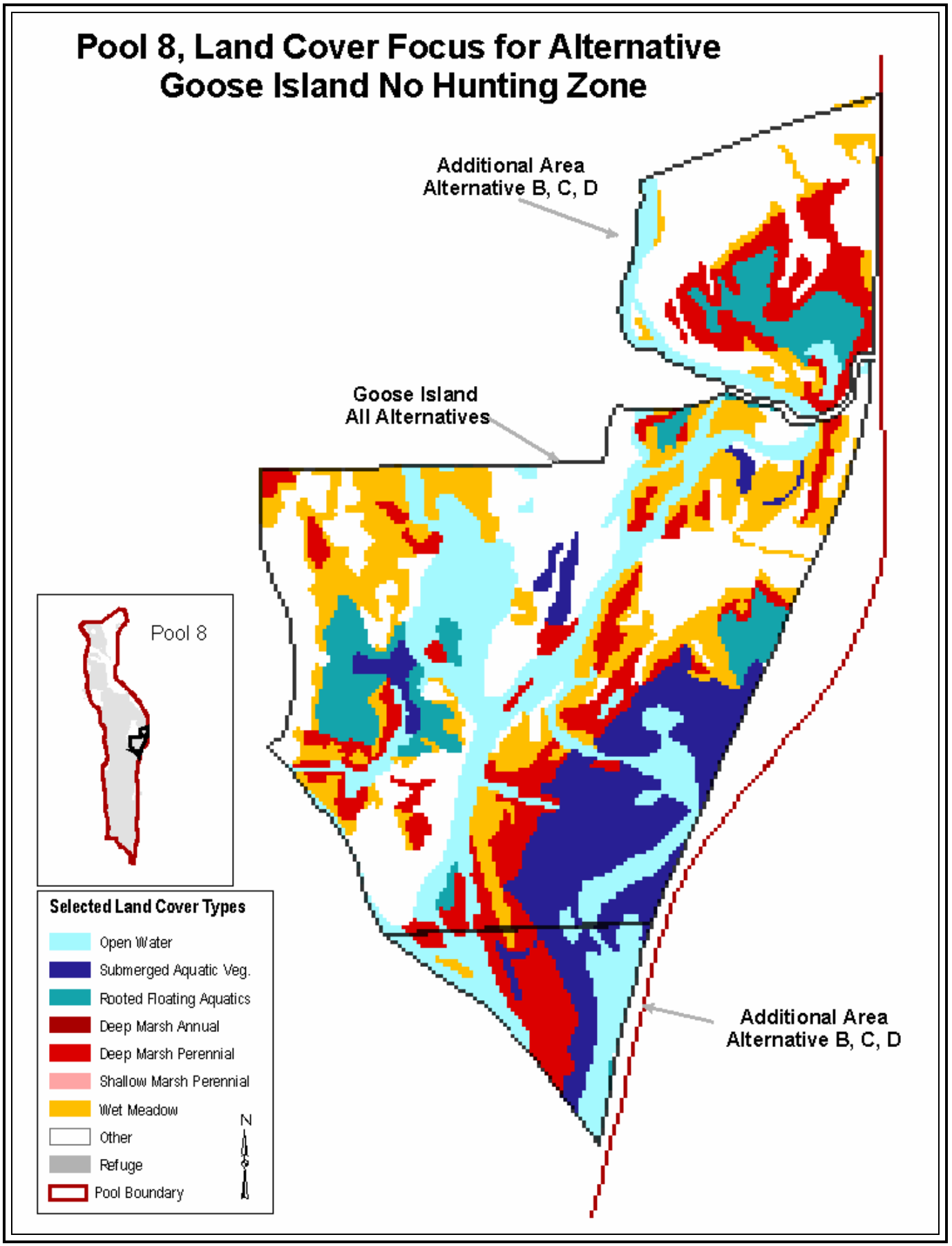
Only 13 % of the pool's Refuge waterfowl plant food gross energy is produced within the closed areas. This is primarily due to the large amount of Open Water within Wisconsin Island closed area (WI). Changes proposed to WI would add 72-95 million Kcal which may not be sufficient to justify the time and effort to reset the boundary of this closed area. Alternative B, C, and D for Goose Island no hunting zone all propose a substantial increase in size including areas with high waterfowl plant food gross energy production. The Map of Distribution of Waterfowl plant food gross energy Estimates represents well how this new addition would include some productive area.



Pool 8, Waterfowl Food Plant Gross Energy Estimates for Current and Alternative Refuge Closed Areas

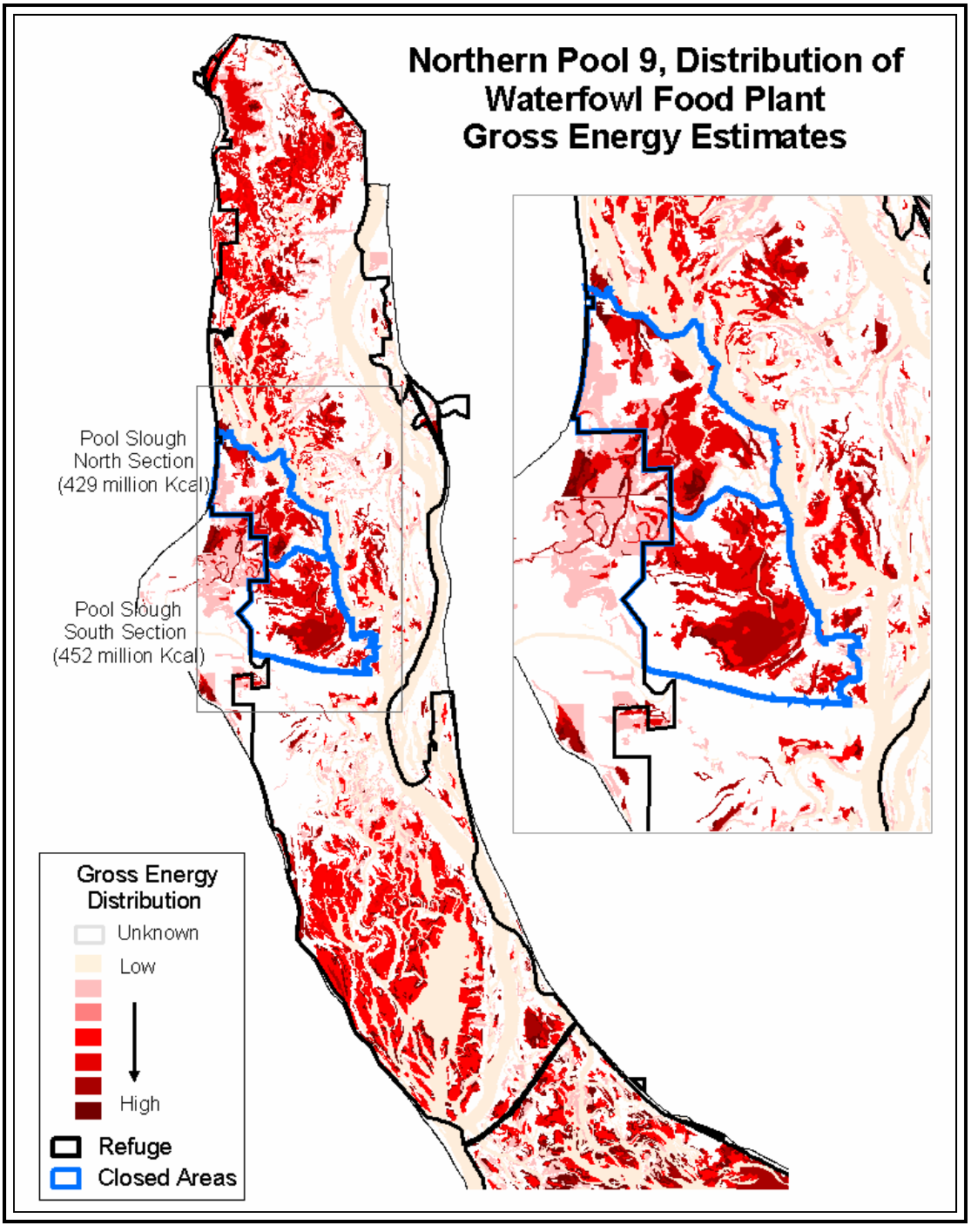


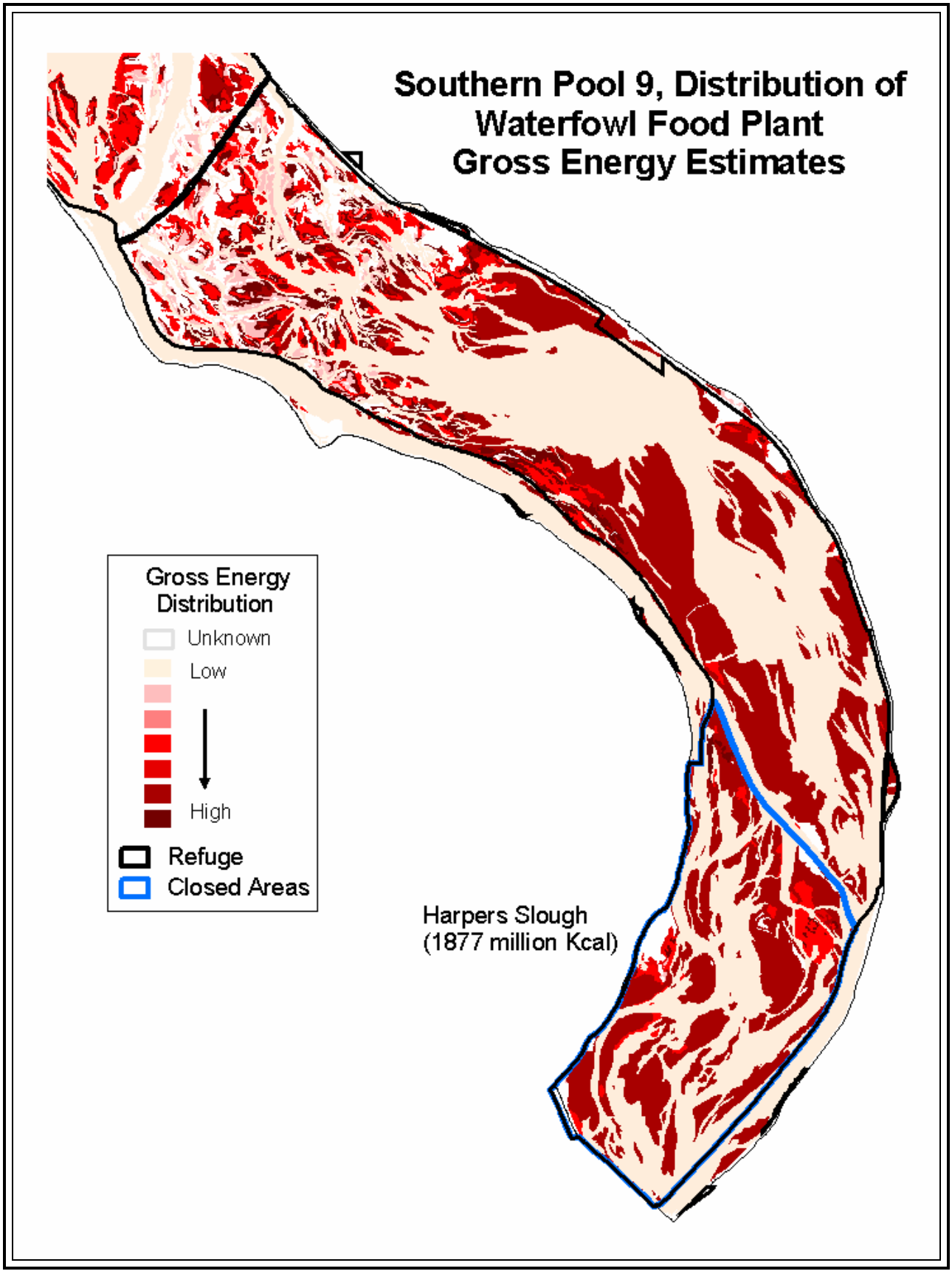
	POOL 8, SUMMARY OF PROPOSED ALTERNATIVES							POOL 8 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	7,332	7,718	5%	7,698	5%	7,698	5%	27,824
Seed (Million Kcal)	51	64	25%	63	24%	63	24%	519
Tuber (Million Kcal)	1,618	2,320	43%	2,298	42%	2,298	42%	11,874
Gross Energy (Million Kcal)	1,669	2,383	43%	2,361	41%	2,361	41%	12,393
Energetics/Acre	0.23	0.31	36%	0.31	35%	0.31	35%	0.45


Pool 8, Land Cover Focus for Alternative
Goose Island No Hunting Zone
Additional Area
Alternative B, C, D
Goose Island
All Alternatives
Pool 8
Selected Land Cover Types
Open Water
Submerged Aquatic Veg.
Rooted Floating Aquatics
Deep Marsh Annual
Deep Marsh Perennial
Shallow Marsh Perennial
Wet Meadow
Other
Refuge
Pool Boundary
N
Additional Area
Alternative B, C, D

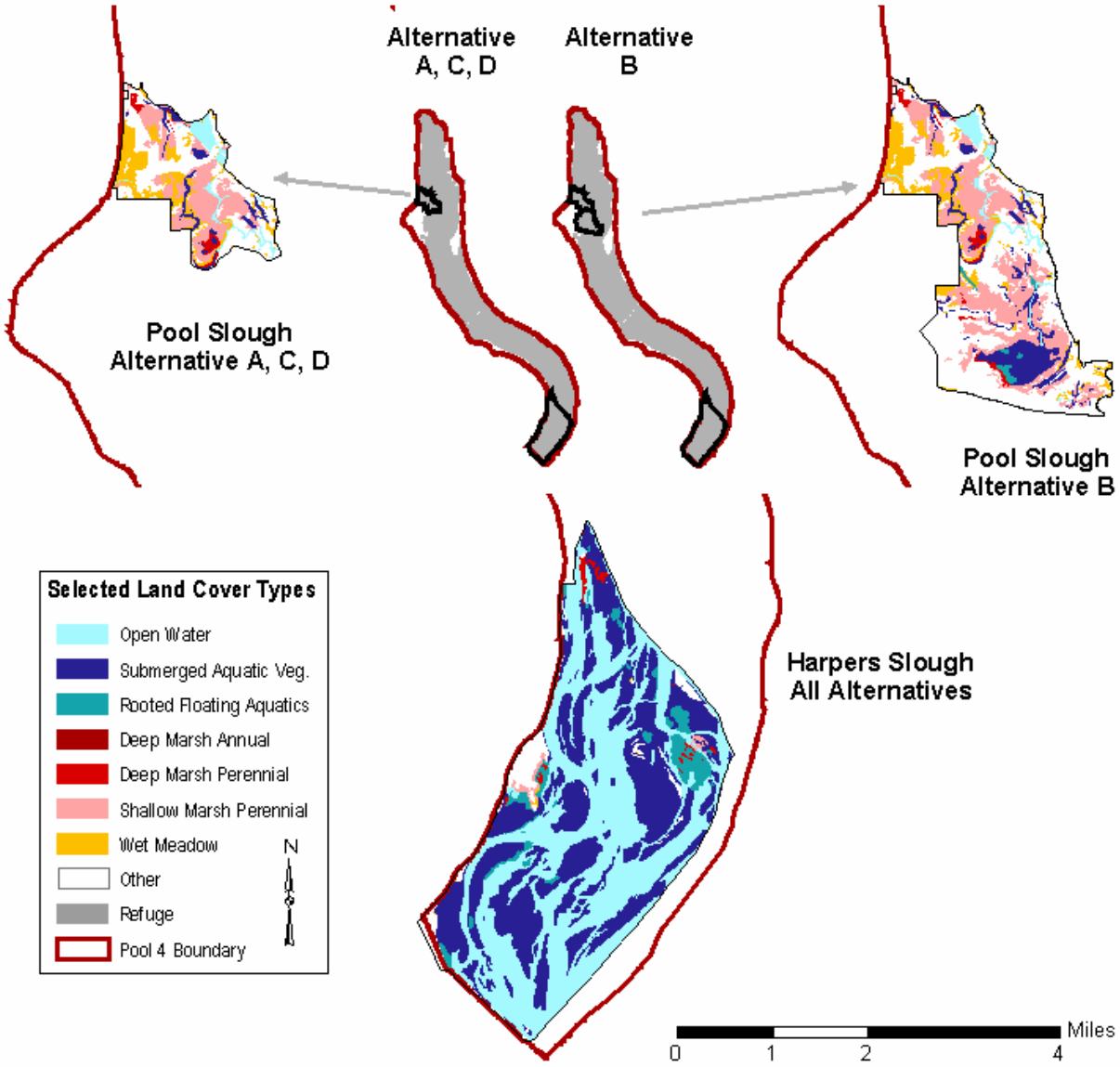
Pool 9

Pool 9 is the most productive Refuge pool between pools 4 -14. The pool's Refuge consists of almost 17,000 million Kcal with 13% of it protected within the existing closed areas. The southern addition on Pool Slough closed area in alternative B would add 452 million Kcal, thus doubling the existing closed area energy production estimates. Most of the pool's waterfowl plant food gross energy production is located in the southern part of the pool. Harpers Pool closed area, which encompasses 2000 acres of Submerged Vegetation, accounts for 80% of the closed area waterfowl plant food gross energy production.




Southern Pool 9, Distribution of
Waterfowl Food Plant
Gross Energy Estimates
Gross Energy
Distribution
Unknown
Low
High
Refuge
Closed Areas
Harpers Slough
(1877 million Kcal)

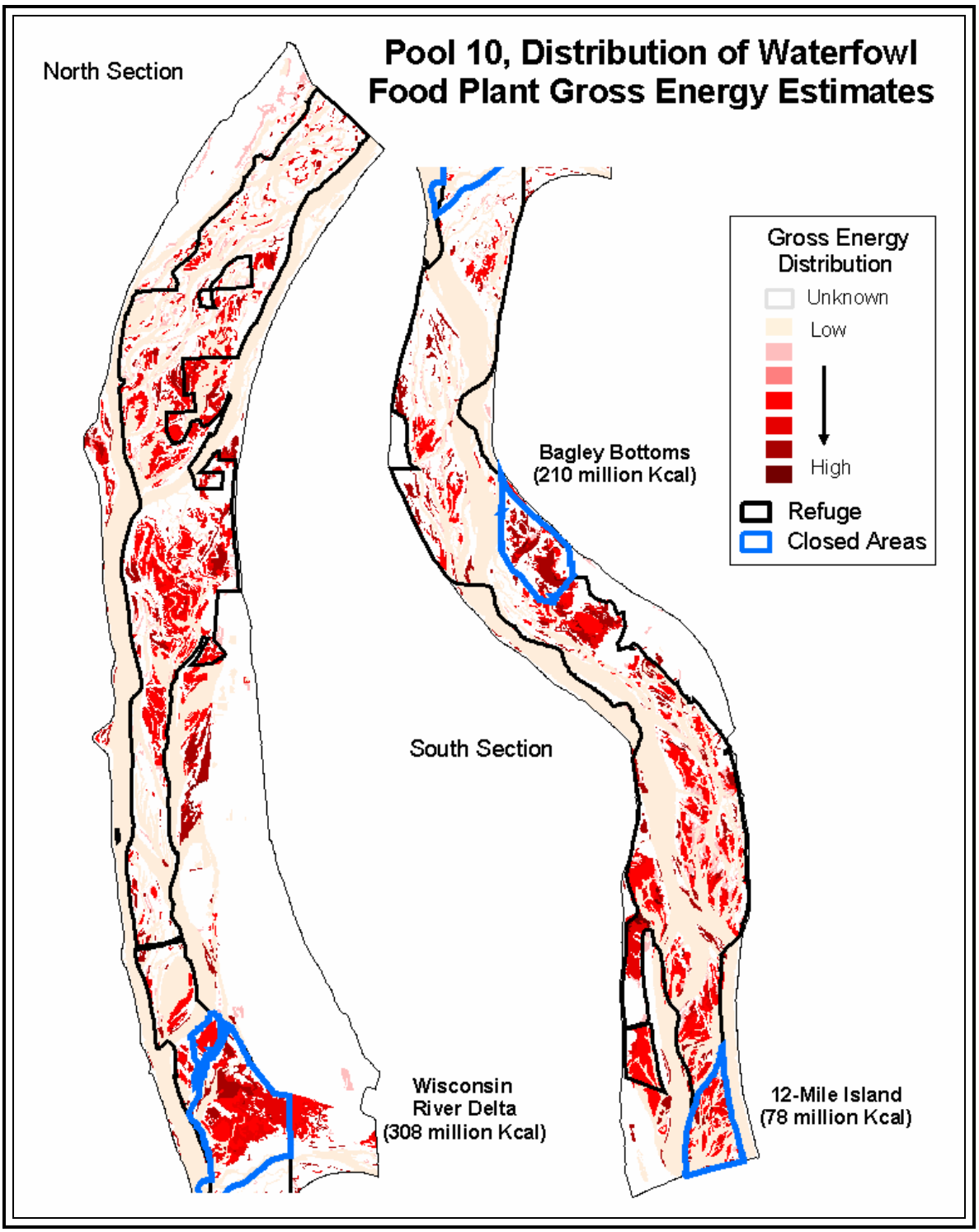
Pool 9, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Refuge Closed Areas



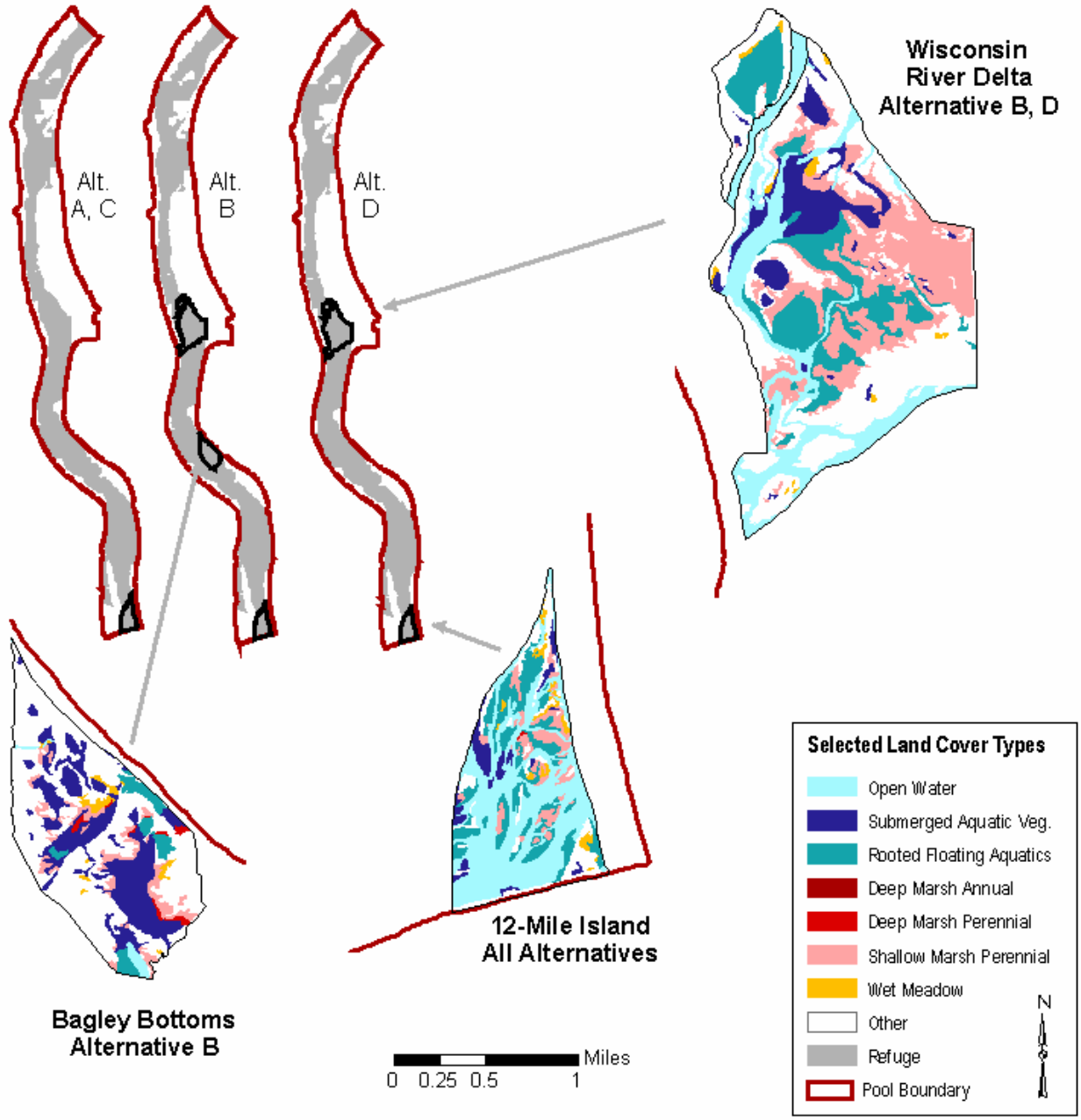
	POOL 9, SUMMARY OF PROPOSED ALTERNATIVES							POOL 9 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	6,292	7,739	23%	6,292	0%	6,292	0%	44,596
Seed (Million Kcal)	70	112	59%	70	0%	70	0%	734
Tuber (Million Kcal)	2,235	2,645	18%	2,235	0%	2,235	0%	16,076
Gross Energy (Million Kcal)	2,306	2,758	20%	2,306	0%	2,306	0%	16,810
Energetics/Acre	0.37	0.36	-3%	0.37	0%	0.37	0%	0.38

Pool 10

Only 3 % of the pool's Refuge 2,689 million Kcal waterfowl plant food gross energy is produced within the only closed area. Waterfowl plant food gross energy production is comparable to pool 4, 5, and 5A Refuges yet only a small fraction is within closed areas in Pool 10. Alternative B, and to a lesser extent D, would add areas with substantially more waterfowl plant food gross energy within the Pool's Refuge by adding 2 and 1 new area respectively. The new closed areas are well located within habitat dense with Deep Marsh Perennial and Submerged Vegetation.



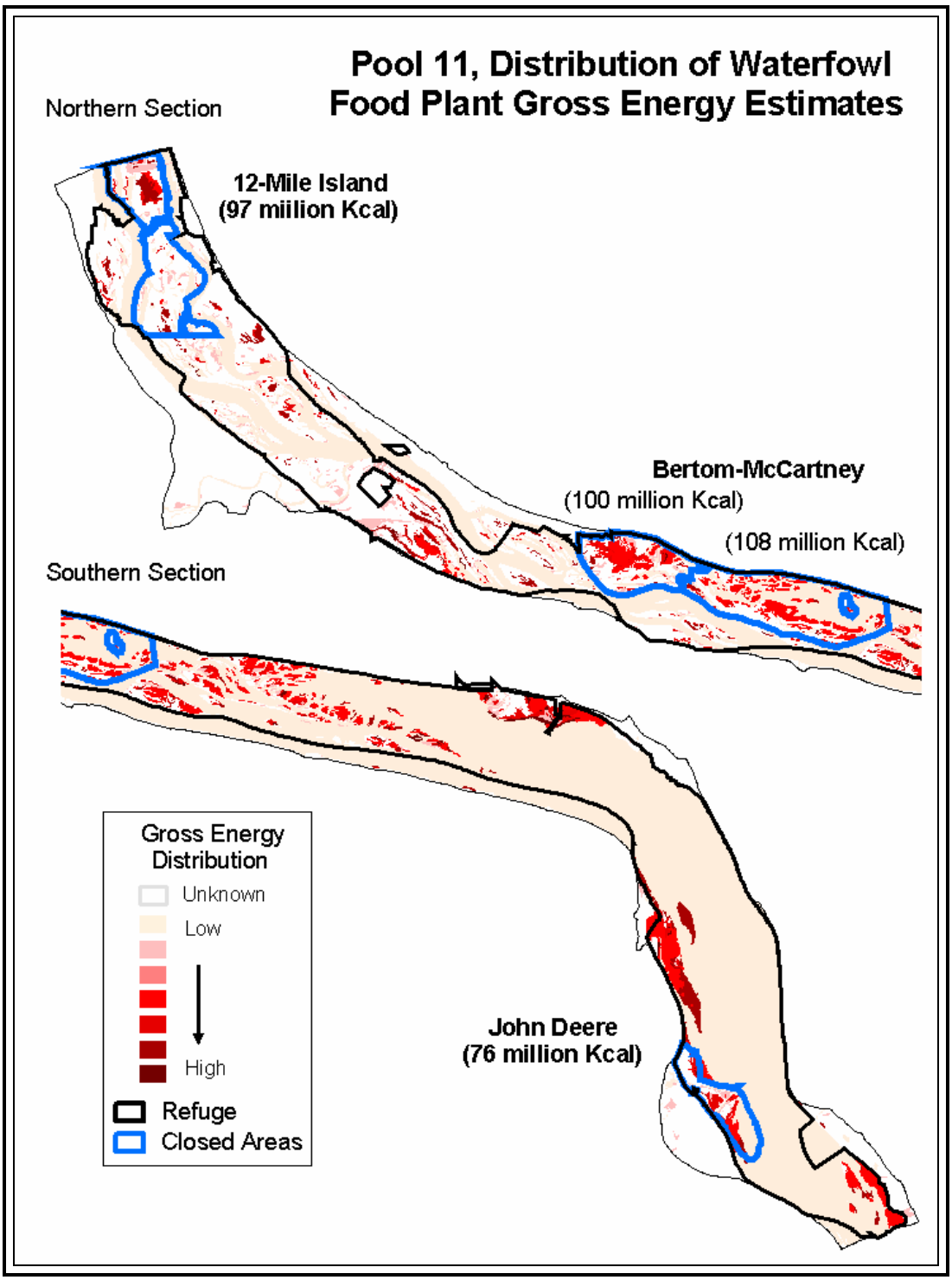
Pool 10, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Closed Areas



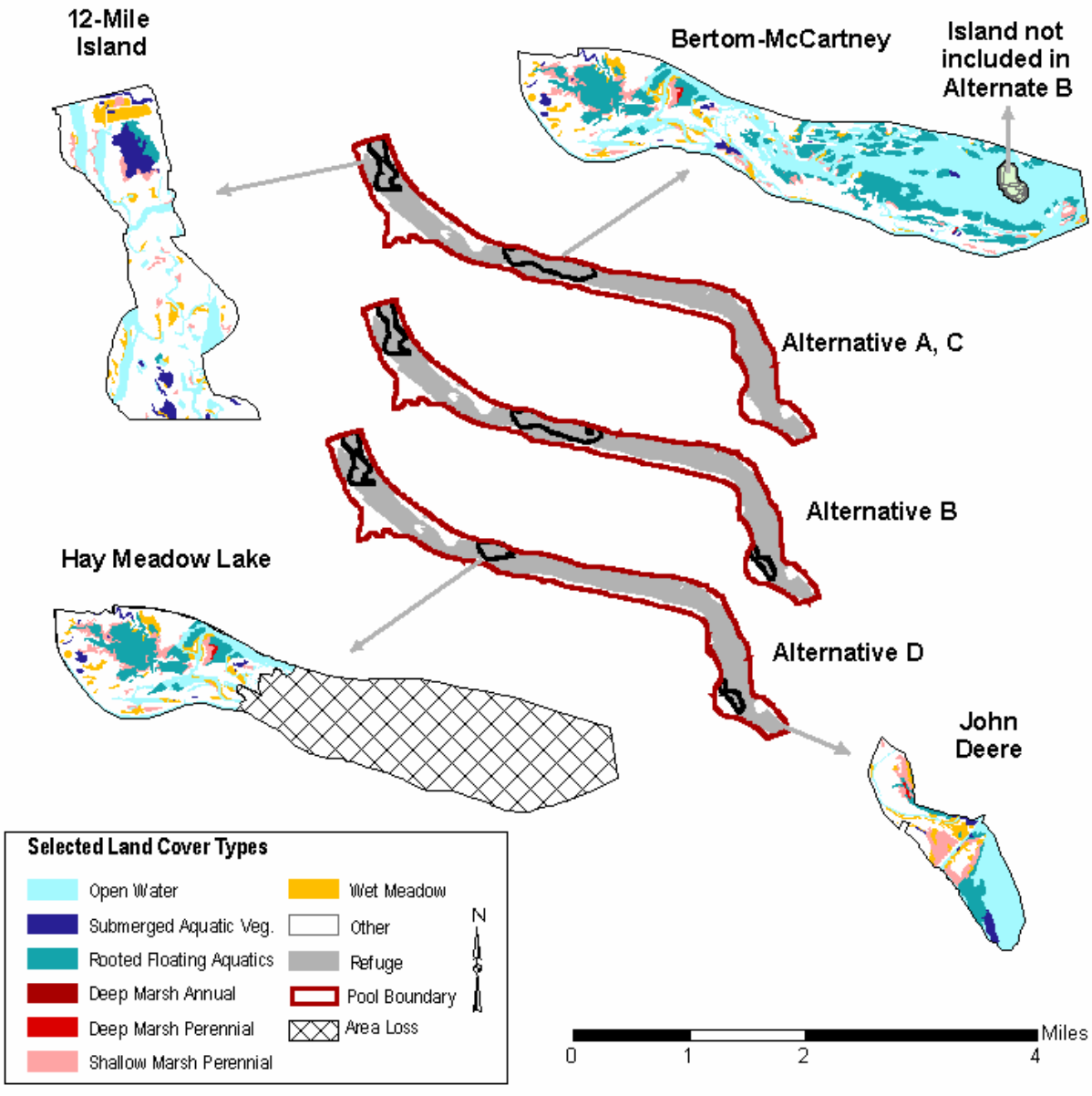
	POOL 10, SUMMARY OF PROPOSED ALTERNATIVES							POOL 10 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	538	3,143	485%	538	0%	2,516	368%	22,200
Seed (Million Kcal)	10	58	482%	10	0%	51	409%	308
Tuber (Million Kcal)	68	538	687%	68	0%	336	391%	2,380
Gross Energy (Million Kcal)	78	596	661%	78	0%	386	393%	2,689
Energetics/Acre	0.15	0.19	30%	0.15	0%	0.15	5%	0.12

Pool 11

The Refuge in pool 11 only produces 2,083 million Kcal. Alternative D in Pool 11 results in a loss of 11% of total waterfowl plant food gross energy. Alternative A, B, and C, are similar with John Deere closed area adding only 78 million Kcal. If the addition of a new closed area in the south would have been located slightly further north, a much greater amount of waterfowl plant food gross energy would have been included within its boundary.



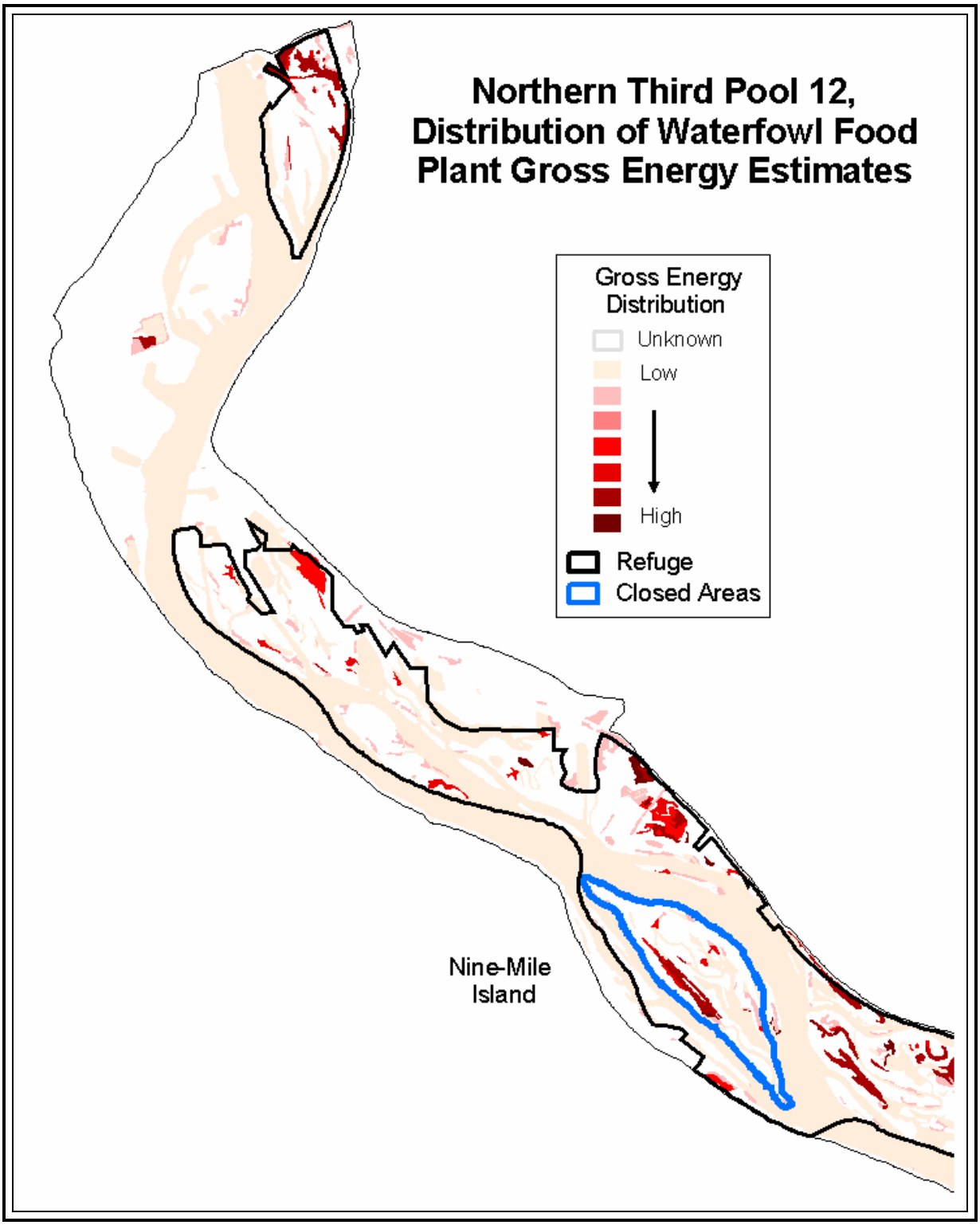
Pool 11, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Refuge Closed Areas

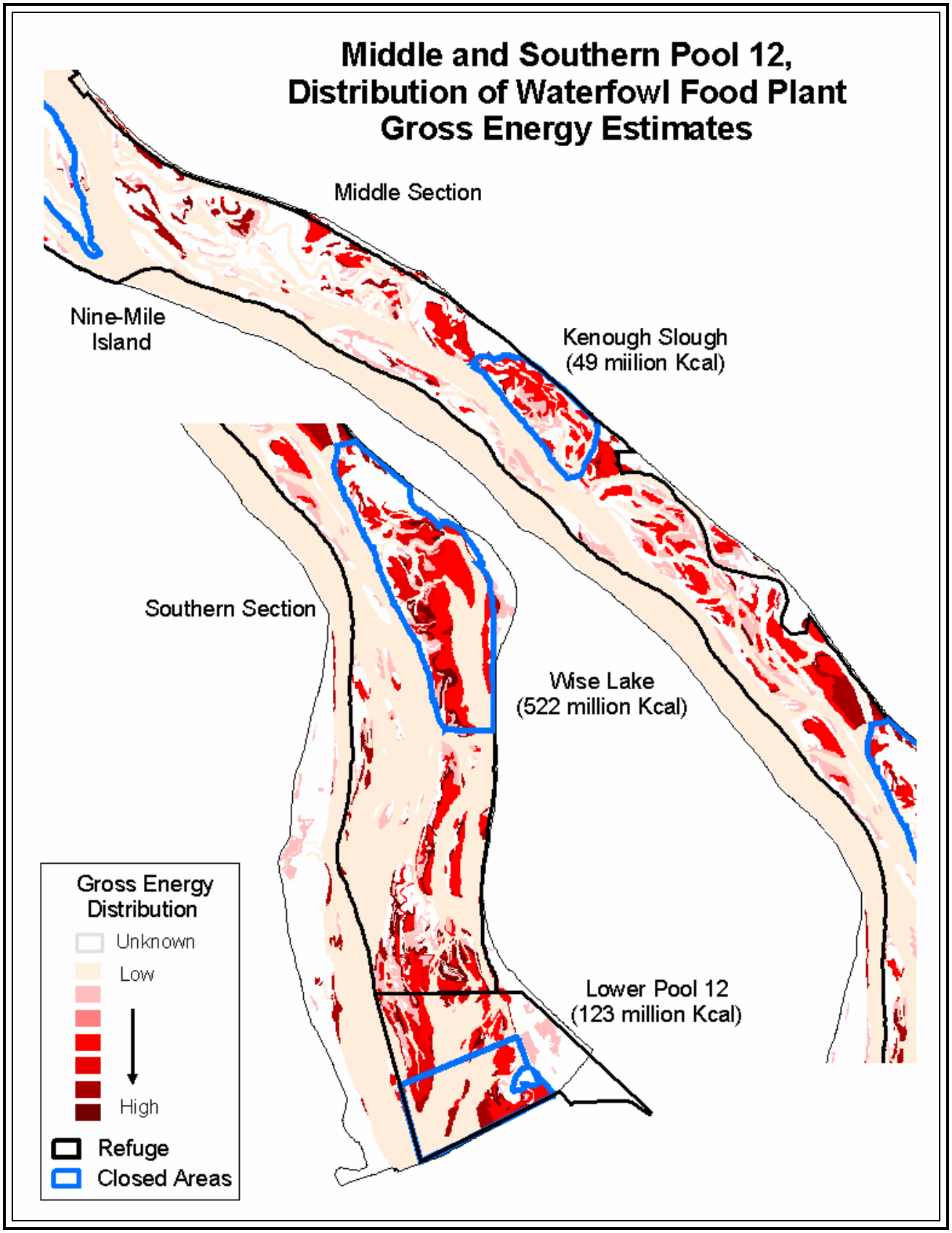


	POOL 11, SUMMARY OF PROPOSED ALTERNATIVES							POOL 11 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	3,810	4,299	13%	3,810	0%	2,756	-28%	24,798
Seed (Million Kcal)	44	54	24%	44	0%	36	-18%	204
Tuber (Million Kcal)	261	325	24%	261	0%	237	-9%	1,879
Gross Energy (Million Kcal)	305	379	24%	305	0%	273	-10%	2,083
Energetics/Acre	0.08	0.09	10%	0.08	0%	0.10	24%	0.08

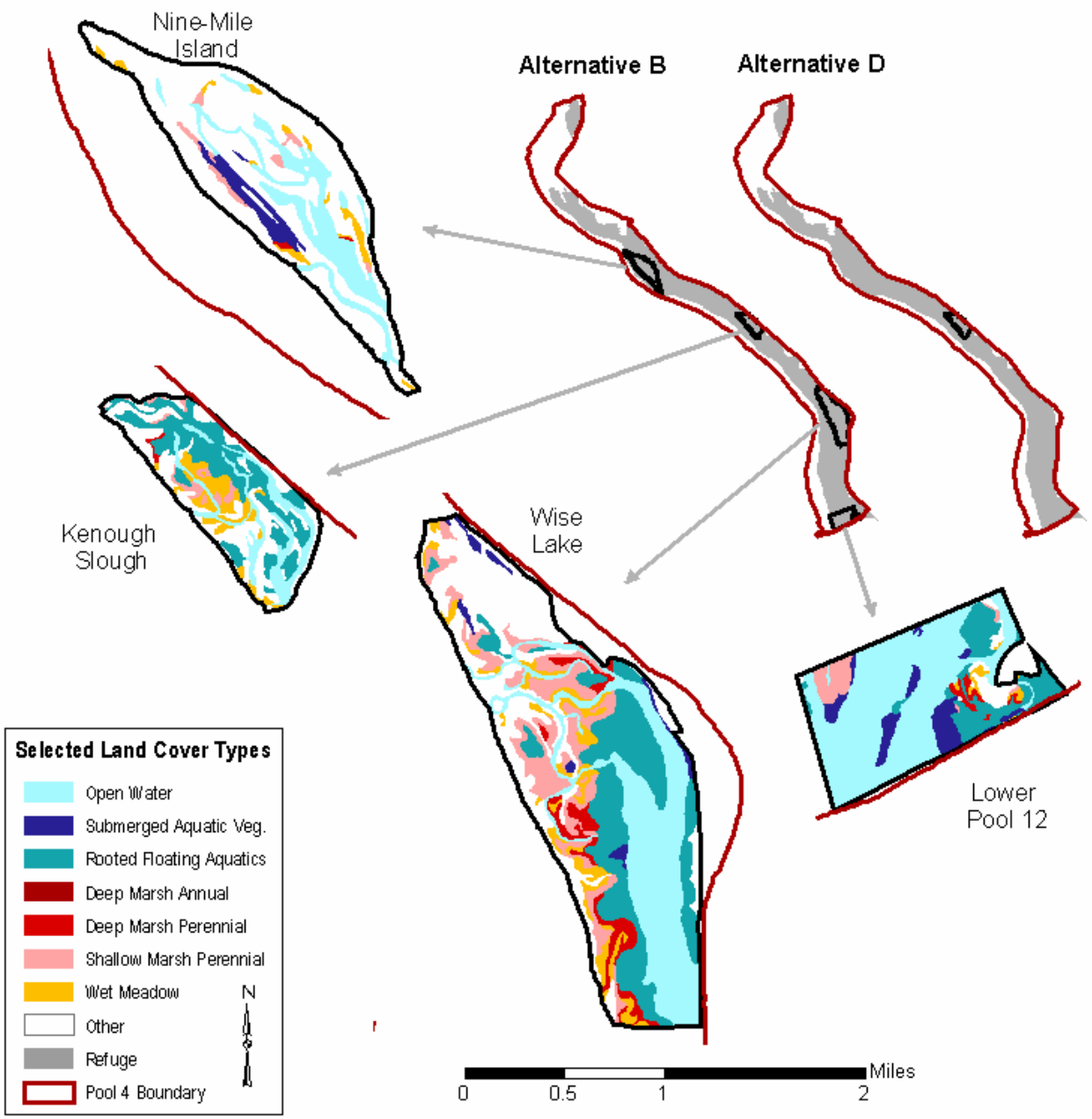
Pool 12

There are no current closed areas present on pool 12. Alternative B would provide the most benefit by protecting 29% of the Refuge's 2,526 million Kcal waterfowl plant food gross energy production. Of the four closed areas proposed, Wise Lake is the most productive. Additionally, all four closed areas are well distributed along the pool. Alternative D, which does not include the most productive closed area, would not be a substantial improvement.




Middle and Southern Pool 12,
Distribution of Waterfowl Food Plant
Gross Energy Estimates
Middle Section
Nine-Mile
Island
Kenough Slough
(49 miilion Kcal)
Southern Section
Wise Lake
(522 million Kcal)
Lower Pool 12
(123 million Kcal)
Gross Energy
Distribution
Unknown
Low
High
Refuge
Closed Areas

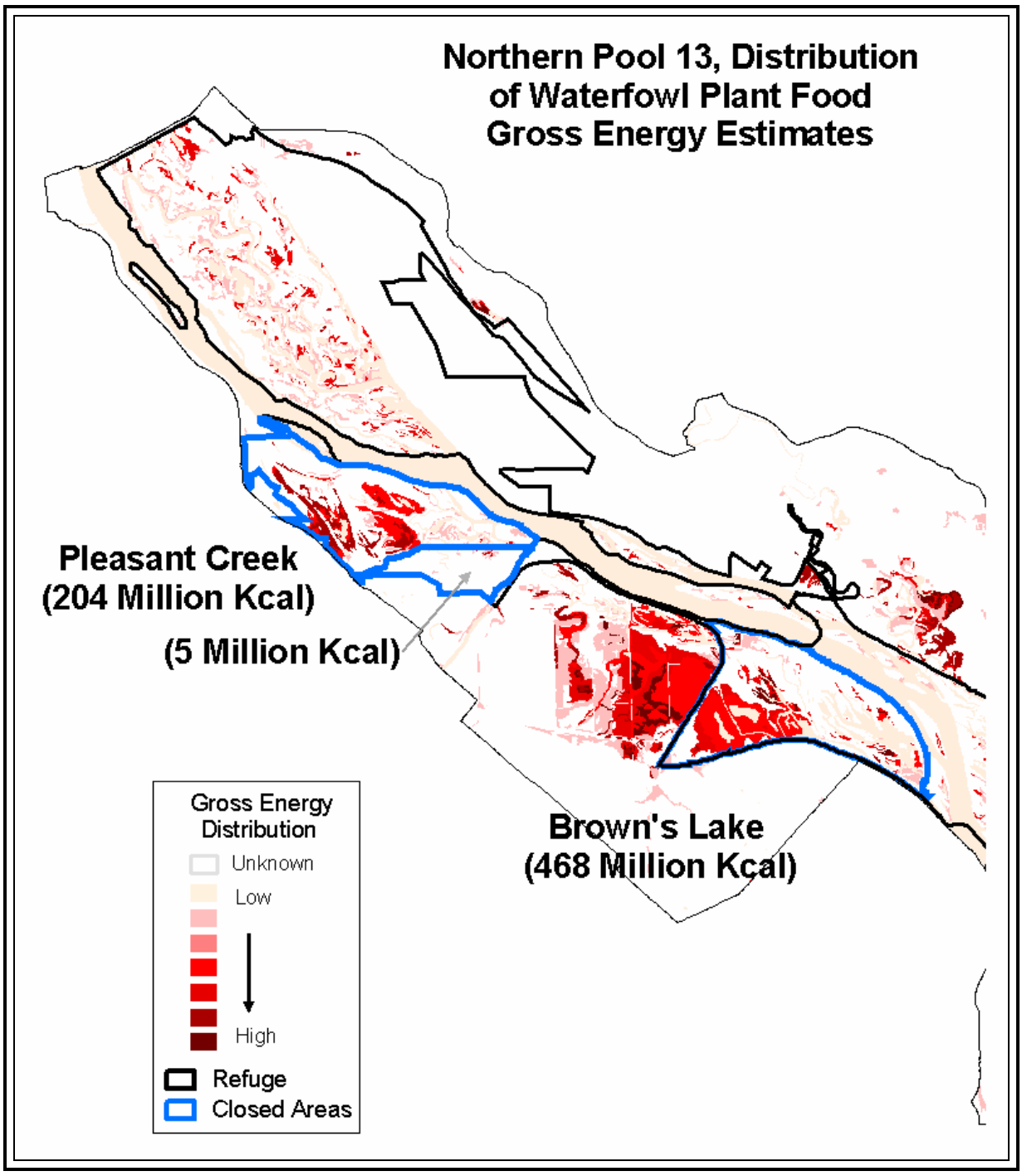
Pool 12, Waterfowl Food Plant Gross Energy Estimates for Alternative Refuge Closed Areas B and D

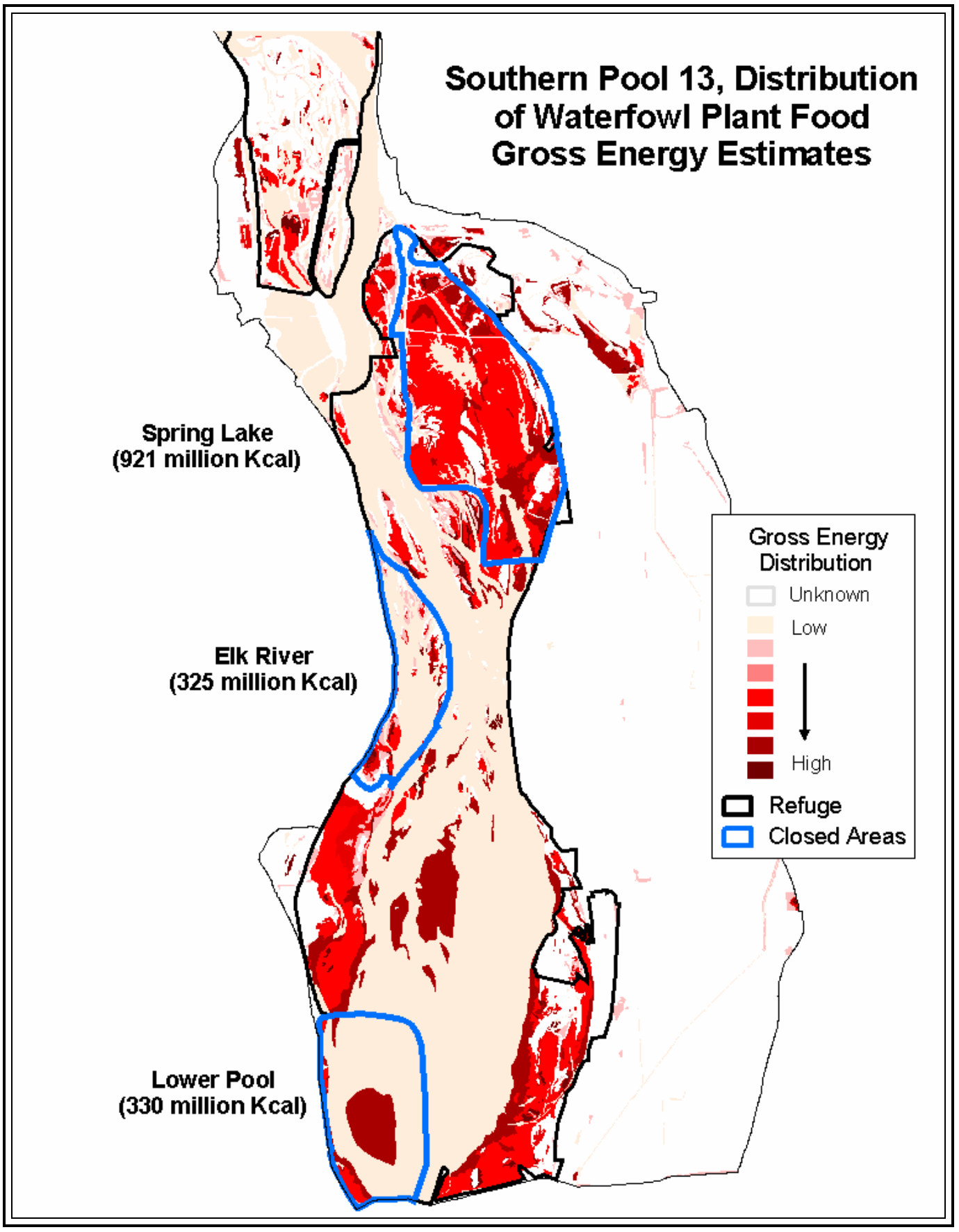


	POOL 12, SUMMARY OF PROPOSED ALTERNATIVES							POOL 12 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	0	2,467	n/a	0	0%	341	n/a	13,277
Seed (Million Kcal)	0	49	n/a	0	0%	8	n/a	172
Tuber (Million Kcal)	0	688	n/a	0	0%	41	n/a	2,354
Gross Energy (Million Kcal)	0	737	n/a	0	0%	49	n/a	2,526
Energetics/Acre		0.30				0.14		0.19

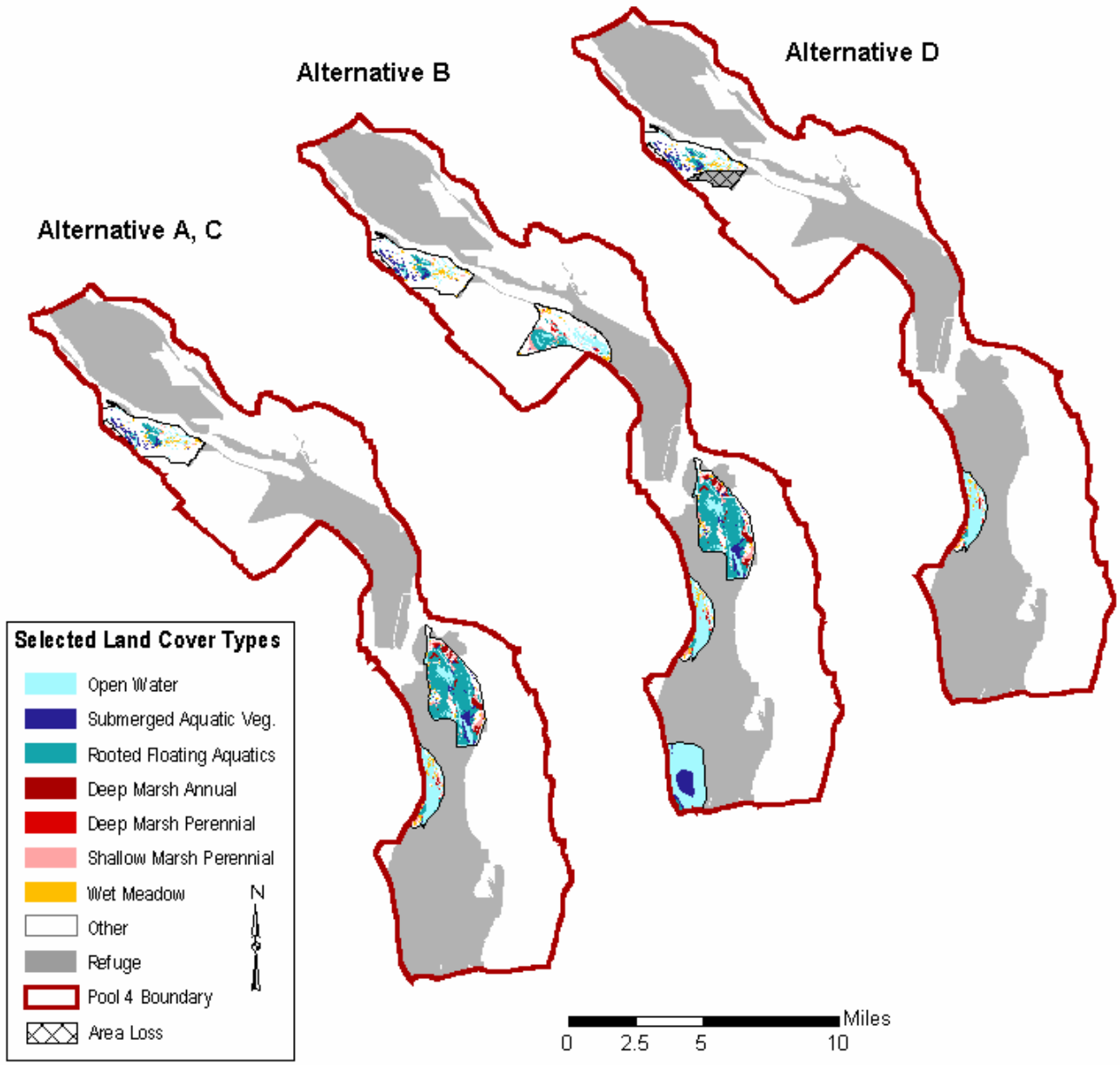
Pool 13

The closed areas in pool 13 currently account for 20% of the pools Refuge 6,928 million Kcal waterfowl plant food gross energy production estimates. Alternative B would add areas with substantially more waterfowl plant food gross energy within the Pool's Refuge by adding Brown's Lake and Lower Pool as a closed areas. Alternative A and C are the same. Alternative D reduces the size of Pleasant Creek closed area by removing a small area with very little potential for waterfowl plant food gross energy production. In alternative B, Brown's Lake is located south of a very productive area and includes a large section of potentially less productive habitat types.

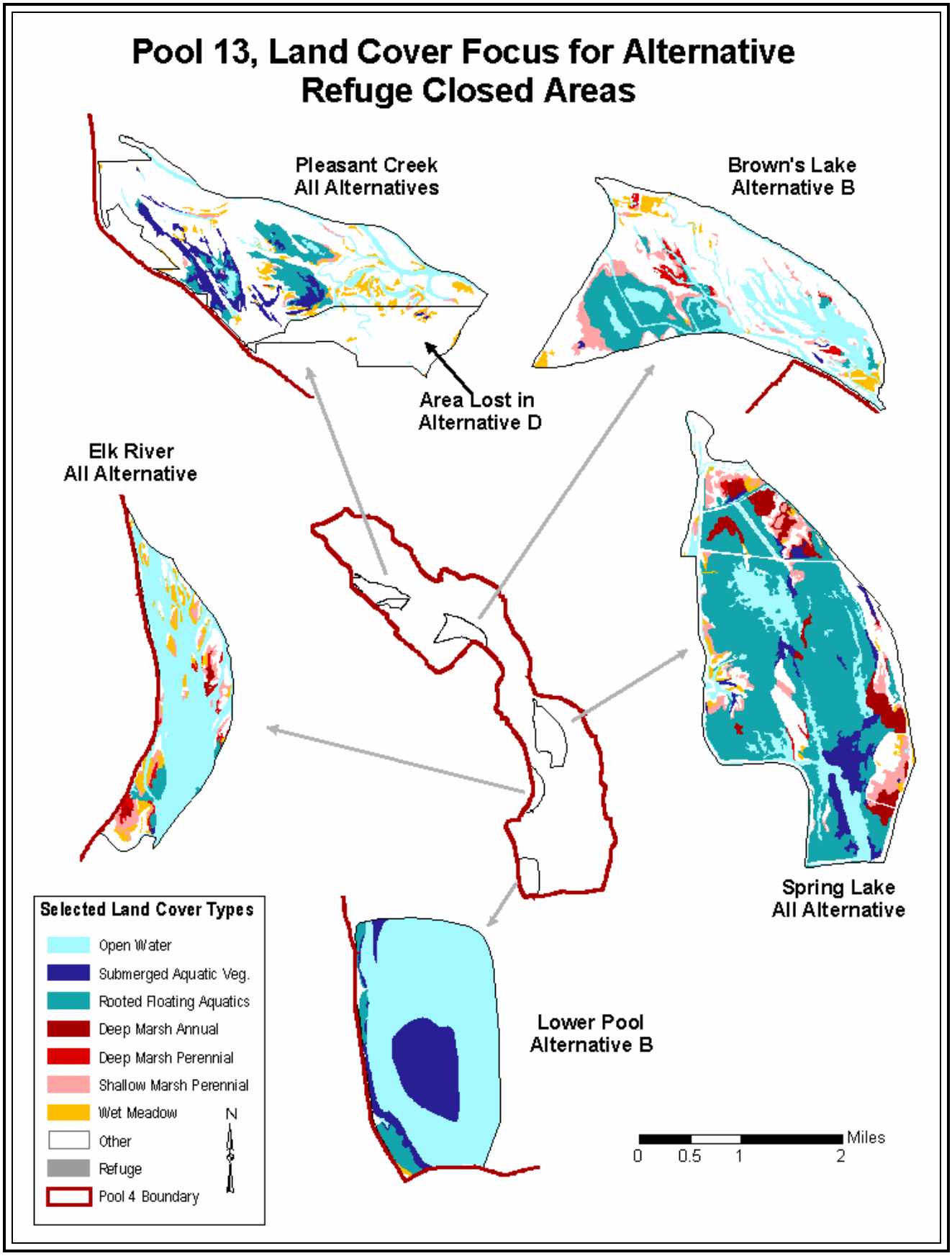



Southern Pool 13, Distribution of Waterfowl Plant Food Gross Energy Estimates
Spring Lake (921 million Kcal)
Elk River (325 million Kcal)
Lower Pool (330 million Kcal)
Gross Energy Distribution
Unknown
Low
High
Refuge
Closed Areas

Pool 13, Waterfowl Food Plant Gross Energy Estimates for Existing and Alternative Refuge Closed Areas

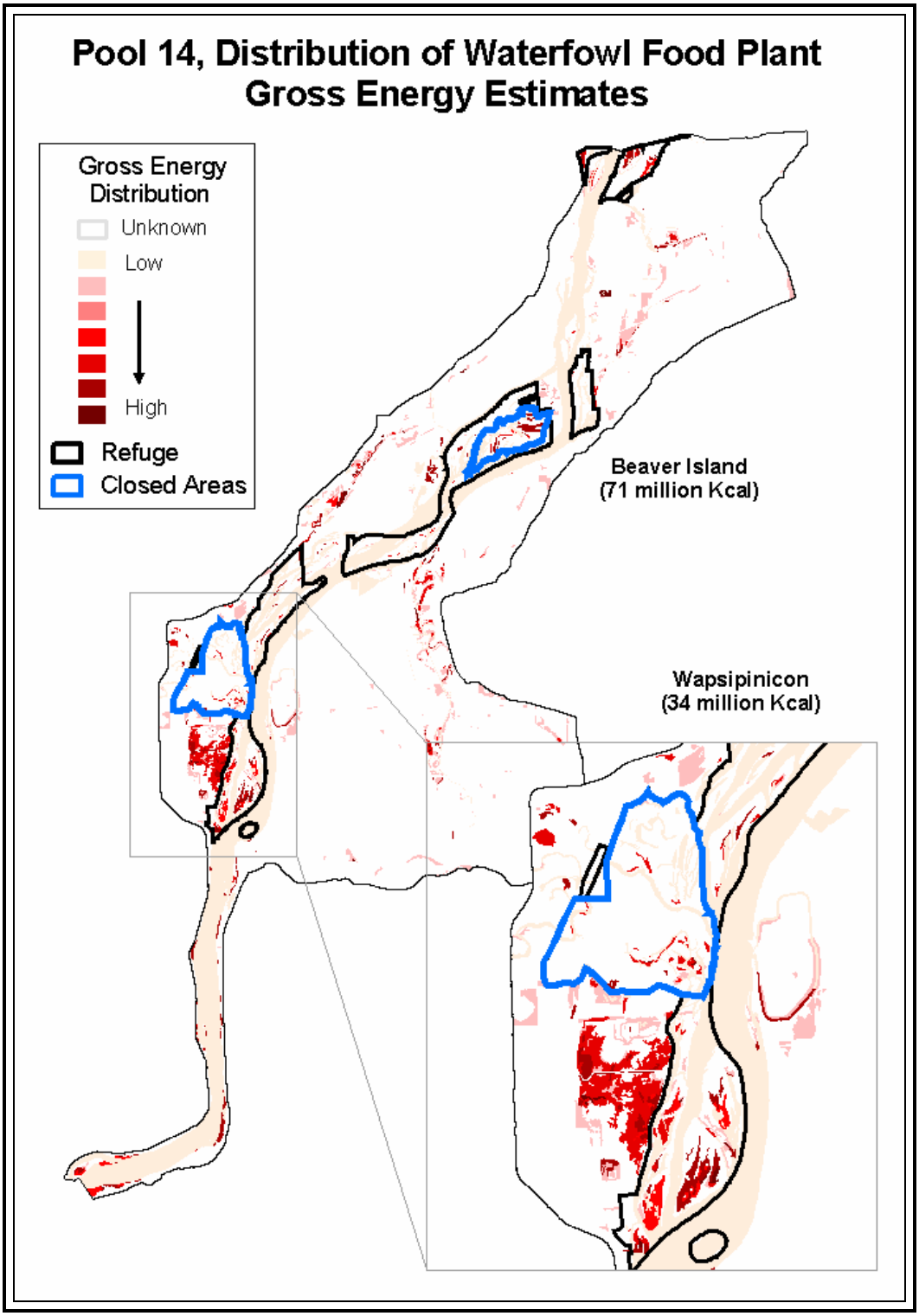


	POOL 13, SUMMARY OF PROPOSED ALTERNATIVES							POOL 13 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	7,525	11,891	58%	7,525	0%	6,989	-7%	42,903
Seed (Million Kcal)	278	323	16%	278	0%	277	0%	638
Tuber (Million Kcal)	1,177	1,930	64%	1,177	0%	1,174	0%	6,289
Gross Energy (Million Kcal)	1,455	2,253	55%	1,455	0%	1,451	0%	6,928
Energetics/Acre	0.19	0.19	-2%	0.19	0%	0.21	7%	0.16

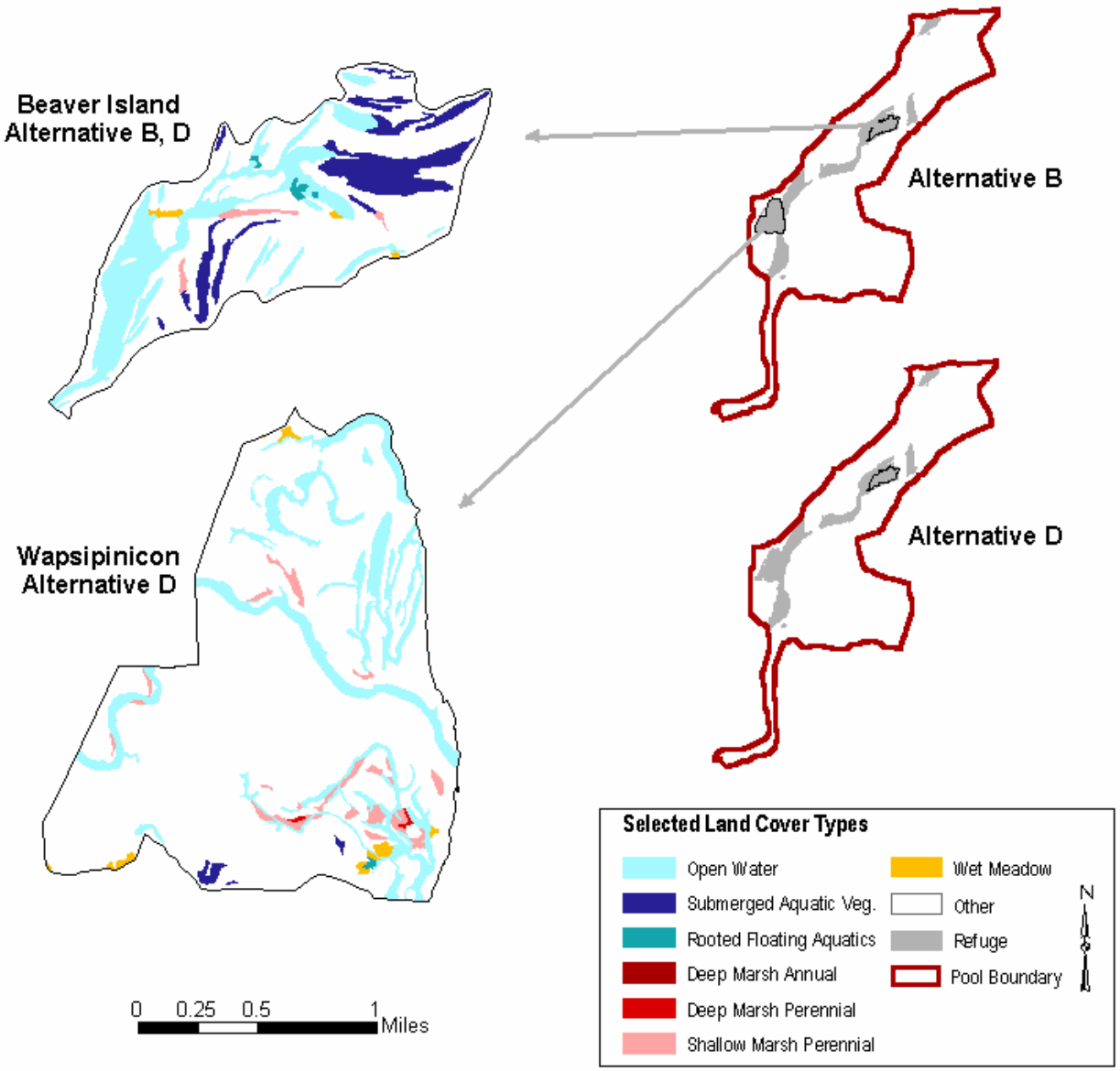

Pool 13, Land Cover Focus for Alternative Refuge Closed Areas
Pleasant Creek All Alternatives
Brown's Lake Alternative B
Area Lost in Alternative D
Elk River All Alternative
Spring Lake All Alternative
Lower Pool Alternative B
Selected Land Cover Types
Open Water
Submerged Aquatic Veg.
Rooted Floating Aquatics
Deep Marsh Annual
Deep Marsh Perennial
Shallow Marsh Perennial
Wet Meadow
Other
Refuge
Pool 4 Boundary
N
Miles
0
0.5
1
2

Pool 14

As in Pool 12, there are no current closed areas present on pool 14. The Refuge on pool 14 has also the lowest energetics/acre production (0.05 million kcal/acre). Alternative B and D would both provide some carrying capacity in two spatially well distributed closed areas. The southern tip of the Refuge in this pool would have included a greater potential for waterfowl plant food gross energy then the currently selected Wapsipinicon closed area.



Pool 14, Waterfowl Plant Food Gross Energy Estimates for Alternative Refuge Closed Areas B and D



	POOL 14, SUMMARY OF PROPOSED ALTERNATIVES							POOL 14 REFUGE
	A - Existing	B - Wildlife Focus		C - Public Use Focus		D - Wildlife & Public Use		
	Total	Total	% Change	Total	% Change	Total	% Change	Total
Total Area (Acres)	0	2,184	n/a	0	0%	717	n/a	7,853
Seed (Million Kcal)	0	6	n/a	0	0%	2	n/a	30
Tuber (Million Kcal)	0	99	n/a	0	0%	70	n/a	380
Gross Energy (Million Kcal)	0	105	n/a	0	0%	71	n/a	410
Energetics/Acre		0.05				0.10		0.05